**Notebook, N-88-04-18**

This notebook, which covers the period April-June 1888, is a continuation of N-88-01-19. It contains transcriptions by Arthur E. Kennelly of material from the rough record books used by experimenters in the Galvanometer Room. Included are notes, drawings, tables, and calculations regarding meters, batteries, carbons, the magnetism of iron and of ore, the electrolysis of chlorine, clocks, phonograph motors, galvanometer constants, generators, lamps, electric power distribution, insulation, and photometer tests. There are also notes on an Armington and Sims engine, the electric light system at Llewellyn Park, and the levelling of the property for the Edison Phonograph Works. Attached to the inside back cover is an index. The front cover is labeled "Record Book No. 2." The spine is labeled "6[3]." The book contains 89 numbered pages. Some pages were removed before the book was paginated. Numerous graphs have been pasted into the book.

The index has been filmed first.

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xE-178 N-88-04-18

# Record Book

of observations

in the

Galvanometer Room

Edison Labor.y

Commenced 18th April 1888.

Concluded 5th June 1888

No. 2.

The susceptibility of several cylinders of iron of various qualities was determined as follows:—

All the cylinders were 1¾" (4·4) in diam.
" " " 6" (15·2) in length
so that their volume would be 231·2. Area 15·205

A rough brass cylinder was made to fit these and cotton covered wire 0·04" = 0·102 wound on it in one layer of 95 turns of 5" mean diam. The length of this solenoid was about the same as that of the iron cores.

Another brass cylinder and solenoid of two or three layers 10 long 5·3 internal and 6 external diam.

In the first series this second solenoid was slipped over the first, and connected to the terminals of a delicate astatic galvanometer whose figure of merit = $3.376 \times 10^8$.

A res: of 50ω (approx) in circuit with the dynamo and inner solenoid completed the (primary) circuit. The induced throw on closing the primary circuit was observed on the galvt.

When no core was in the coil the induced throws were

2/4
23·75
23·75 } 23·8

Temp: of room 70°F Dynamo pot. diff. 114

Ulster - iron core inserted. Marked end up.

263
260·5 } 260·4
257
261

Marked end down } 262·2 − 23·8 = 238·4

265
264·5 } 264
242·5

---

East - iron core inserted
Marked end (I.C) up.

250·25 } 248·6
248·
247·5

Marked end down } 248·8 − 23·8 = 225·0

249 } 249
250
248

---

East wrought iron core inserted, lost specimen, many blow holes
Marked end up.

220·5 } 217·2
215
216

Marked end down } 225 − 23·8 = 201·2

240
230·5 } 232·8
228

---

5% Manganese
Marked end up

200
185·25 } 191·75
190·

Marked end down } 192·3 − 23·8 = 168·5

199·75
190· } 192·8
188·75

10% Manganese (very hard specimen)

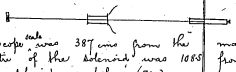
Marked-end up

57.5
55 } 55.8
55

Marked end down } 55.4 − 23.8 = 31.6

55.5
54.75 } 55
54.75

Tried the experiment with the aid of a magnetometer, using the Kohlrausch bifilar magnetometer for that purpose.



The telescope scale was 387 cms from the centre of the solenoid was 1085 from the magnet and current in solenoid as before (50 ω)

| | | | |
|---|---|---|---|
| No ~~correction~~ | 0.315 divs = ~~0.595~~ | 0.630 cms deflection | |
| Ulster iron: marked end | towards mirror | 3.14 = 6.28 cms | 6.31 − 0.63 = 5.68 |
| | away from | 3.17 = 6.34 | |
| East iron | towards | 2.97 = 5.94 | 5.93 − 0.63 = 5.30 |
| | from | 2.96 = 5.92 | |
| East wrought iron | towards | 2.86 = 5.72 | 5.72 − 0.63 = 5.09 |
| | from | 2.86 = 5.72 | |
| 5% Manganese | towards | 2.51 = 5.02 | 5.02 − 0.63 = 4.39 |
| | from | 2.51 = 5.02 | |
| 10% Manganese | towards | 0.76 = 1.52 | 1.95 − 0.63 = 0.865 |
| | from | 0.735 = 1.47 | |

Taking Ulster iron as unity we have

| | Induction method | Magnetometer method | Mean |
|---|---|---|---|
| East iron | 94.38% | 93.31 | 93.8 |
| East wrought | 84.39 | 89.61 | 87.0 |
| 5% Manganese | 70.68 | 77.28 | 74.0 |
| 10% Manganese | 13.25 | 15.23 | 14.2 |

No 1 Armington Simms Engine :-

Diameter 14·5" = 165 sq. in area

Diam rod 2·25" = 4

Stroke 15" = 1·25.

Back Const: $= \frac{165 \times 1.25}{33,000} = 6.250 \times 10^{-3}$

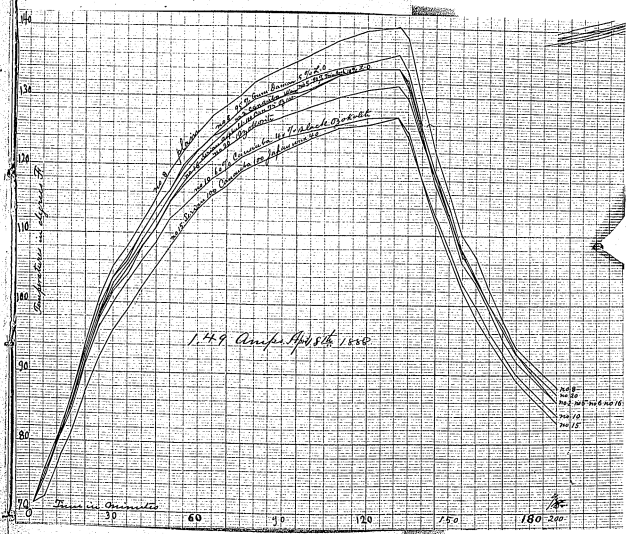
Front Const $= \frac{161 \times 1.25}{33,000} = 6.10 \times 10^{-3}$

At 14. 5. 4. 88 The speed being 250 revs : air press. by planimeter about 15 lbs.

The H.P. was reckoned at 46.

Took a comparatively rough determination of the temp: coeff: of the new Tay bridges. Tested B. by A. and then heated B. for about 3 hours.

| B coil | @ Temp. = | A coil @ Temp. | B coil | @ temp | = A coil @ temp. | Ring Gr | K per °C. |
|---|---|---|---|---|---|---|---|
| 1000 | 17.7° | 999.75 | 1000 | 19.3 | 1003.93.35 | 3.50 | 0.025 |
| 100 | | 99.96 | 100 | | 100.08 | | |
| 10 | | 9.993 | 10 | | 10.003 | | |
| 10 | | 9.992 | 10 | | 10.039 | | |
| 100 | | 99.98 | 100 | | 100.43 | | |
| 1000 | | 999.44 | 1000 | | 1006.10 | 4.65 | 0.033 |
| 5000 | | 4993.95 | 5000 | | 5019.25 | 25.30 | 0.026 |
| 2000 | | 1999.15 | 2000 | | 2010.25 | 10.10 | 0.029 |
| 1000 | | 999.25 | 1000 | | 1005.45 | 6.30 | 0.025 |
| 1000 | | 999.20 | 1000 | | 1005.55 | 6.35 | 0.025 |
| 500 | | 499.92 | 500 | | 502.85 | | |
| 200 | | 199.92 | 200 | | 200.85 | | |
| 100 | | 99.98 | 100 | | 100.43 | | |
| 100 | | 99.98 | 100 | | 100.32 | | |
| 50 | | 49.96 | 50 | | 50.21 | Mean | 0.037 |
| 20 | | 19.98 | 20 | | 20.06 | | |
| 10 | | 10.00 | 10 | | 10.06 | | |
| 10 | | 10.00 | 10 | | 10.05 | | |
| 5 | | 4.97 | 5 | | 4.99 | | |
| 2 | | 2.0 | 2 | | 2.04 | | |
| 2 | | [illegible] | 2 | | 2.04 | | |


140
130
120
110
100
90
80
70
0
30
60
90
120
150
180
200
No 8
No 20
No 2
No 4
No 6
No 16
No 10
No 12
1.49 Amps April 5th 1900

Thursday 19th April

Measured the res: of a certain quality of ore.

1st Powdered and in a receptacle for a carbon telephone button transmitter so as to form a column 0·3 high and 1·75 in diam.
The res: was then observed to be about 0·6ω
The area being 2·376, the res: referred to unit area = 1·426ω and referred to unit volume = 4·752ω = spec: res: in ohms.

A small irregularly ~~solid~~ cubical block about 0·3 each side offered about 1300ω between the ends of two no 20. copper wire pressed upon opposite faces, corresponding to about 300ω say per c.c.

A solid block roughly a parallelopiped about 1"×1½"×½" was coated with tinfoil on each 1½"×½" side and the res: between the coatings observed to be nearly ∞.

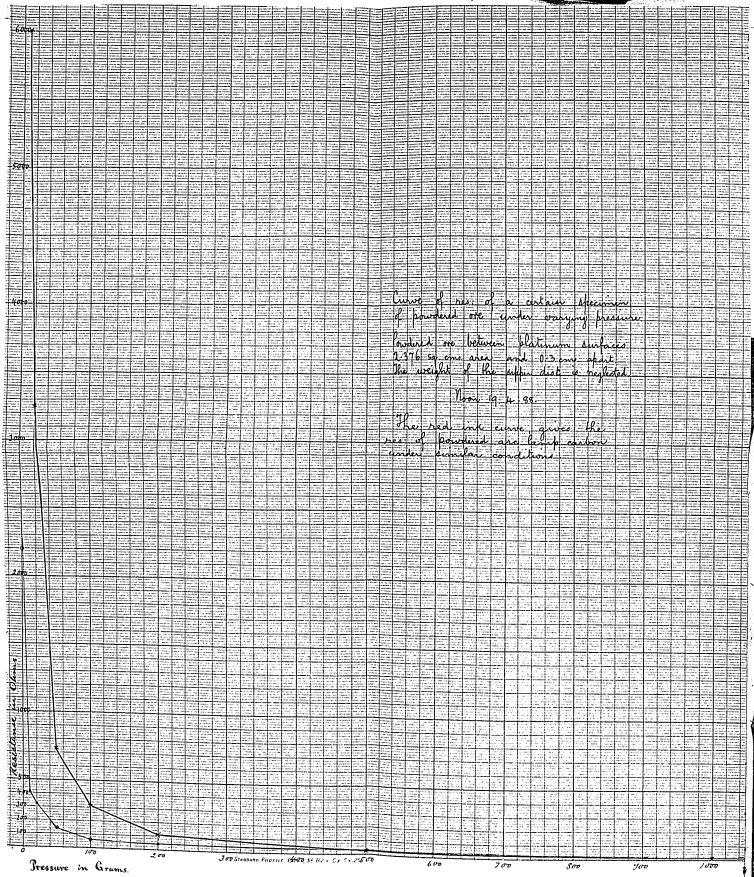
Some more powdered material was now poured into the receptacle and the res: measured. It was found to be very variable with the superincumbent pressure. The accompanying curve shows the reading.

Wound a spool with wire of following dimensions.

| | | | |
|---|---|---|---|
| Length | Over all | $6\frac{5}{32}$ | 16.2 |
| | Inter-flanges | 6 | 15.25 |
| Inner Diam. of cylinder | | $1\frac{7}{16}$ | 4.46 |
| Inner Diam. of spool | | $2\frac{1}{8}$ | or 5.4 cm. |
| Flange Diam. | | $4\frac{1}{8}$ | 10.5 |

The wire was double cotton covered Diameter of conductor . of covered wire.

| | | | | |
|---|---|---|---|---|
| The first layer had | | 107 turns | and | D. 5.67 |
| - | 2nd | 106 | - | 5.90 |
| - | 3rd | 105 | - | 6.22 |
| - | 4th | 105 | - | 6.48 |
| - | 5th | 104.5 | - | 6.62 |
| - | 6th | 105 | - | 6.83 |
| - | 7th | 105 | - | 7.12 |
| - | 8th | 105 | - | 7.40 |
| - | 9th | 105 | - | 7.58 |
| - | 10th | 105 | - | 7.75 |
| - | 11th | 105 | - | 8.10 |
| - | 12th | 105 | - | 8.48 |
| - | 13th | 105 | - | 8.62 |
| - | 14th | 105 | - | 8.90 |
| - | 15th | 105 | - | 9.10 |
| - | 16th | 104 | - | 9.40 |
| - | 17th | 104 | - | 9.60. |
| | Total | 1785 | | |
| | ave. | 105. | | |

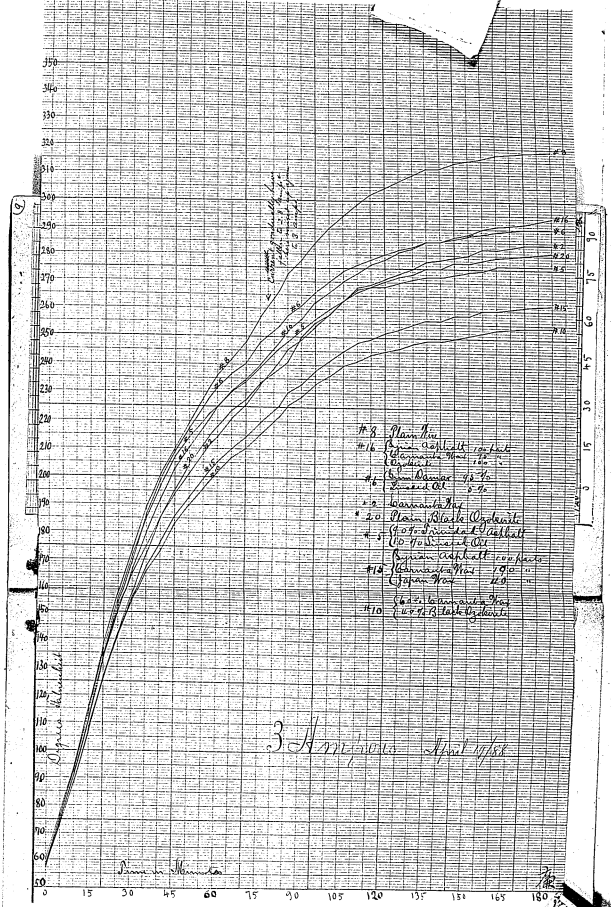


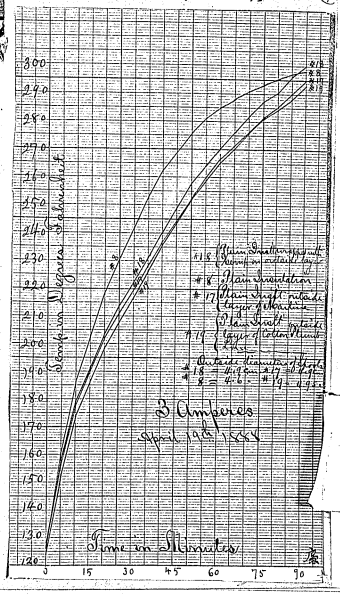

Curve of resist. of a certain specimen of powdered ore under varying pressure which was between platinum surfaces 2.376 sq. cms area and 0.3 cms thick. The weight of the upper disk is neglected.

Mon 9 p. 99

The red ink curve gives the resist. of powdered ore below under similar conditions.

B


Temperatur in Grad Celsius
Zeit in Minuten
0 15 30 45 60 75 90 105 120 135 150 165 180
60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350
#9 Planchen
#16 Asphalt 10 Liter
Benzin Wax 10 "
Carbolsäure 10 "
#1 Benzin Wax 15 %
Rüböl 85 %
#2 Carbolsäure Wax
#20 Planchen Wachs Carbolsäure
#3 Rüböl Carbolsäure
#10 Rüböl Carbolsäure
Benzin Asphalt 10 Liter
#12 Schmierseife Wax 10 "
Benzin Wax 10 "
#4 Schmierseife Wax
#10 L.V.V. Wachs Carbolsäure
3 Anzeichen April 1888


Temp. in Degrees Centigrade
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
0
15
30
45
60
75
90
Time in Minutes
3 Ambores
April 18th 1884
#18
#17
#19

## Friday 20th April.

Owing to dampness of weather, reel of wire burst one flange, replaced it, and succeeded in obtaining a trial series with Norway iron.

---

The phonograph motors, have 4 magnets each of two spools of wire, each spool offering about 0·3ω and 6 layers of 40 turns or 240 turns. In one magnet there are thus 480 turns and 0·6ω. In two magnets arranged for quantity there will be 0·3ω. The working current is about 2 amperes or 960 ampere turns. Say that 1000 ampere turns are now needed.

As the magnets are now to be in series, the ampere turns in each spool are to be 250.

The winding space of each spool is
$(1{\cdot}77^2 - 0{\cdot}56^2) \times 0{\cdot}4854 \times 2{\cdot}17$ cubic inches $= 4{\cdot}80$
If d be the diam. of the wire now to be employed $4{\cdot}8\frac{d}{2}$ = length in inches.
The length of the mean turn $= \pi \times 1{\cdot}67$
The no. of turns $= \frac{0{\cdot}6}{d} \times \frac{2{\cdot}17}{d} = \frac{1{\cdot}302}{d^2}$
The res: of the wire $=$
If no 30 wire be employed its diam. is 0·012"
Its length on one spool would be $\frac{4{\cdot}5}{1{\cdot}20 \times 10^{-4}} = 30{,}000$ in
or 2500 feet. $\times 0{\cdot}072 = 180\,\omega$. Four such spools would offer $720\,\omega$ and the current would be $\frac{100}{720}$ or 140 millimpères. By counter EMF at 80 volts this would be reduced to 30 millimpères. The no. of turns $= \frac{1{\cdot}302}{1{\cdot}44 \times 10^{-4}} = {\cdot}9 \times 10^4 = 9000$.
The no. of ampere turns on each spool is therefore $9000 \times 0{\cdot}03 = 9 \times 10^3 \times 3 \times 10^{-2} = 270$.

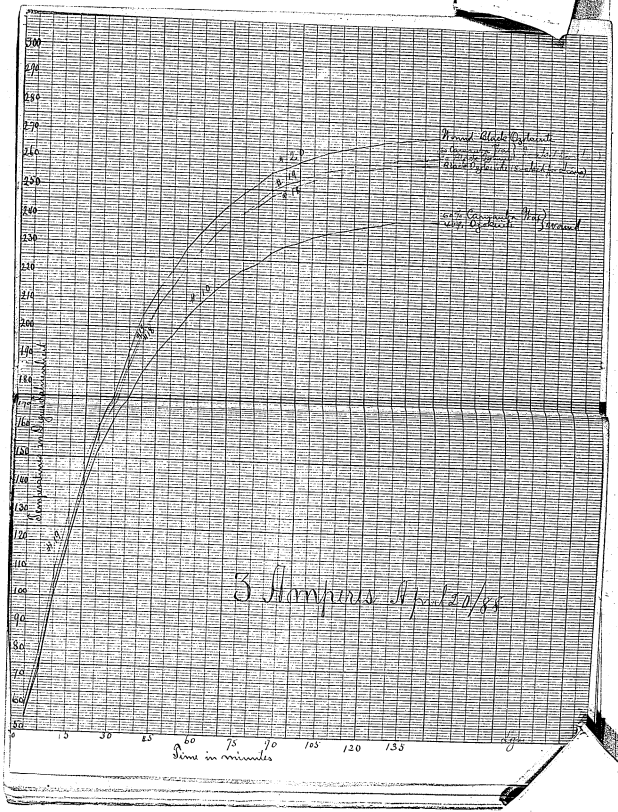
Measured the angles between the half silvered mirror of the portable magnetometer by means of the spectrometer, and made them

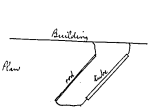
Between 1st + 2nd mirrors 11° 57′. 15″
- 1st + 3rd - 18° 32′. 00″

With the coil detailed on page 7
the exciting power from n amperes would be

$\frac{4\pi}{10} \times 1785n = 1.25664 \times 1785 \times n \quad 2243\,n$

This multiplied by k the coefficient for iron
$= 2243\,nk$
and the area of the iron face being 15.2
this becomes 147.5 nk lines per sq. cm.
Assuming $n = 3$ and $k = 32.8$ this expression
becomes 14,500 or about 80% of full ~~saturation~~


Normal Chloride Electrolyte
Temperature Range
Chloride Electrolyte Mixed to Dilute
64% Concentration Mixed Normal
Dip Electrode
Temperature in Degrees Centigrade
Time in minutes
3 Amperes April 27/85






## Monday 23rd April

Measured the res: of a stick of carbon arc 0·1165" diam. 9·6 cms offset a res: of 7·5 approx. The diam being 0·296 cms, its area = 0·0688 sq. cms. Had its diam been 0·005" or 0·012 cm. its res would have been $\frac{7.5 \times 0.296 \times 0.0688}{0.012 \times 0.012}$ = 4000.

## Tuesday 24th April

Tried an experiment with the view of localising grounded mains as follows.

An ordinary 20 foot 3 wire tube was set outside the building ~~in a~~ roughly horizontal and in the magnetic meridian as closely as could be estimated by the eye.

Some 20 feet away and parallel to the tube a copper rod about ½" diam was laid. The tube and rod were both supported about 2 feet from the ground on boxes.

The Dynamo current passed from the Galvr. mains out through one window to the tube, from the tube to the rod and from the rod back to the mains in the building after passing through an A.H. ammeter and a Siemens Dynr.

Banks of lamps in the Boiler room allowed the current to be controlled.

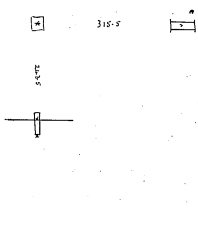
The following readings were taken.

| No. | Coil | Amperes Act'l | Amperes Dig'l | Result | Resist: Ampes: | Dist: of Cube stone mill | Observed Deflect: | Calculd Deflect | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Tube | 16 | 26·20 | 16·28 | 25 | 39 | 19° | 22°·50′ | Dist: slight |
| 2 | Rod | 15·5 | 23° | 15·17 | - | 52 | 17° | 16°·50′ | - |
| 3 | Tube | 15·5 | 23° | 15·17 | - | 41 | 19° | 20°·50′ | - |
| 4 | Rod | 15·5 | 22° | 14·83 | - | 52 | 17° | 15°·25′ | - |
| 5 | Rod | 28 | 80° | 28·3 | 50 | 52 | 29°·20′ | 28°·50′ | Remained |
| 6 | Tube | 28·5 | 77°·30 | 27·63 | - | 41 | 35°·20′ | 34°·50′ | slightly. |
| 7 | Tube | 28 | 77 | 27·5 | - | 41 | 35°·20′ | 34°·50′ | Remained |
| 8 | Tube | 28 | 76 | 27·6 | - | 41 | 35°·20′ | 34°·50′ | " |

The following experiments were made to determine the magnetic qualities of the iron cores.

The dist: from the centre of the magnet to the centre of the coil = 315·5

The dist: from the centre of the magnet to the centre of the scale = 243·5



| Time Secs | C. 3.3 ambient temp. | Nottcutt Core | Nonney Iron | Ulster Iron | Cast Iron | Cast wrought | 5% Manganese | 18% Manganese |
|---|---|---|---|---|---|---|---|---|
| | | secs | | | | | | |
| 0 | | 0 | −0.01 | 0 | +0.15 | −0.06 | +0.01 | 0.0 |
| 1 | | 0.12 | +0.59 | 0.60 | 0.73 | 0.575 | 0.58 | 0.295 |
| 2 | | 0.30 | 1.195 | 1.23 | 1.27 | 1.08 | 1.12 | 0.560 |
| 3 | | 0.42 | 1.77 | 1.79 | 1.80 | 1.61 | 1.65 | 0.80 |
| 4 | | 0.62 | 2.37 | 2.39 | 2.395 | 2.19 | 2.16 | 1.075 |
| 5 | | 0.70 | 2.91 | 2.92 | 2.91 | 2.80 | 2.68 | 1.240 |
| 6 | | 0.87 | 3.495 | 3.45 | 3.50 | 3.37 | 3.22 | 1.50 |
| 7 | | 0.96 | 4.065 | 4.04 | 4.05 | 3.88 | 3.71 | 1.68 |
| 8 | | 1.11 | 4.620 | 4.62 | 4.65 | 4.44 | 4.25 | 1.86 |
| 9 | | 1.19 | 5.13 | 5.14 | 5.22 | 4.94 | 4.70 | 2.08 |
| 10 | | 1.29 | 5.70 | 5.59 | 5.71 | 5.42 | 5.17 | 2.18 |
| 11 | | 1.395 | 6.20 | 6.13 | 6.27 | 5.93 | 5.66 | 2.38 |
| 12 | | 1.48 | 6.72 | 6.65 | 6.72 | 6.44 | 6.13 | 2.52 |
| 13 | | 1.54 | 7.34 | 7.19 | 7.27 | 6.96 | 6.56 | 2.68 |
| 14 | | 1.60 | 7.84 | 7.70 | 7.66 | 7.42 | 7.00 | 2.83 |
| 15 | | 1.68 | 8.40 | 8.23 | 8.11 | 7.94 | 7.43 | 2.93 |
| 16 | | 1.71 | 8.90 | 8.75 | 8.56 | 8.42 | 7.86 | 3.04 |
| 17 | | 1.74 | 9.48 | 9.28 | 9.06 | 8.94 | 8.30 | 3.18 |
| 17½ | | −0.19 | −0.09 | −0.04 | +0.10 | 0.18 | +0.32 | +0.30 |
| 300 | | | −0.09 | −0.07 | +0.04 | 0.08 | +0.08 | +0.01 |

The res: per cm: of no 22 B.W.G. wire would be (0.072 cm diam) area 0.00407 sq cm

$= \frac{4.0 \times 10^{4}}{4.07 \times 10^{-3}} = 1 \times 10^{7} = 0.04\,\omega$ or about 1 metre to the ohm so for $120\,\omega$ we should require about 120 metres of the wire.

The res: of no 25 wire $0.020^{+} = 0.050$ cm $= 0.0020$ sq. cms area $= \frac{4.0 \times 10^{4}}{2.0 \times 10^{-3}} = 2 \times 10^{7}$

$= 0.02\,\omega$ or 50 cms to the ohm or 60 metres to $120\,\omega$

The res: of no 26 wire $0.018^{-} = 0.045$ cm $= 0.0016$ sq cms area $= \frac{4.0 \times 10^{4}}{1.6 \times 10^{7}} = 2.5 \times 10^{7}$

$= 0.025\,\omega$ or 40 cms to the ohm or 48 metres to $120\,\omega$

## Wednesday 25th April.

From the results obtained on the 7th Mar: p. 49; the spec: res: of the platinoid wire @ per sample was $4.0 \times 10^{4}$.

The res: of one cm. of this wire of diam d. cms $= \frac{16.0}{\pi d^2} \times 10^{4} = \frac{1.6}{\pi d^2} \times 10^{5}$

The energy expended by a current of c units in traversing one cm. is thus $\frac{1.6c^2}{\pi d^2} \times 10^{5}$ ergs and the heat developed per sec. is

$$\frac{1.6c^2 \times 10^{5}}{4.2\,\pi d^2 \times 10^{7}} = \frac{0.381 \times 10^{-2} c^2}{\pi d^2} = \frac{3.81c^2 \times 10^{-3}}{\pi d^2}$$

$$= \frac{1.1126c^2 \times 10^{-3}}{d^2} \text{ 2. calories}$$

The energy radiated per sec. at 145° C. excess

$$= 45^{\circ} \times \pi d \times 2 \times 10^{-4} \text{ per cm.}$$

$$= 90\,\pi d \times 10^{-3} = 282744\, d \times 10^{-3} = 2.827 \times 10^{2} d$$

Equating these

$$1.1126c^2 \times 10^{-3} = 2.827 d^3 \times 10^{-2}$$

$$d^3 = \frac{1.1126 \times 10^{-1} c^2}{2.827}$$

$$= 3.962 \times c^2 \times 10^{-2} \text{ where } c \text{ is in amps}$$

$$\therefore d = \sqrt[3]{3.962\, c^2 \times 10^{-2}} =$$

say $\sqrt[3]{4c^2} \times 10^{-2}$ where

If $c = 1$ $d = \sqrt[3]{400} = 7.37 \times 10^{-2} = .0737$ cm

$$c^2 = \frac{d^3 \times 10^{4}}{3}$$

taking $d = 0.081$ $c = \sqrt{\frac{8.1^3 \times 10^{-2}}{3}} = \frac{5.88 \times 10^{-2}}{3} = \frac{5.88}{3}$

$$= \sqrt{2.7 \times 10^{-2}} = \sqrt{1.96}$$

$\sqrt{1.96 \times 10^{-1}}$ 1.5 approx.

The strength of field produced by one layer of wire is approximately.

$\frac{4\pi}{10} \times \frac{10.5}{15.3} \times 3.114$ or $27.37$ H



## Thursday 24th April

Adjusted the permanent mirrors of the portable magnetometer in such a manner that the large ones are within 20' of parallelism and each is within 20' of being at right angles to the central strip.

Also determined the angles of the strips to be :—

Upper and central . 6°. 36'. 30"

Lower - - 11°. 51'. 45"

The calculated values of the magnet readings p. 15

Coil Without Core :—

| Coil | Current amperes | Magnetizing Force. H | Moment. | $\frac{\text{Moment}}{H}$ |
|---|---|---|---|---|
| | 3.7114 | 27.113 | $1.47 \times 10^3$ | |
| 2 | 3144 | 54.225 | 3.675 " | |
| 3 | | 81.339 | 5.145 - | |
| 4 | | 108.45 | 7.596 - | |
| 5 | | 135.56 | 8.545 - | |
| 6 | | 162.68 | $1.066 \times 10^4$ | |
| 7 | × | 189.79 | 1.176 - | |
| 8 | | 216.90 | 1.360 - | |
| 9 | | 244.02 | 1.458 - | |
| 10 | | 271.13 | 1.580 - | |
| 11 | | 298.24 | 1.709 - | |
| 12 | × | 325.36 | 1.813 - | |
| 13 | | 352.47 | 1.887 - | |
| 14 | | 379.58 | 1.960 - | |
| 15 | | 406.70 | 2.058 - | |
| 16 | | 433.81 | 2.095 - | |
| 17 | | 460.92 | 2.132 - | |
| | out | 460.35 | ~~439~~ | 439 |

| No. of Circuits | Mean current Ampères | Magnetizing powers | Moment of coil reversal | Intensity moment volt. | Lines per sq. cm. | Susceptibility Nonmag. |
|---|---|---|---|---|---|---|
| 1 | 3.1444 | 33.64 | $7.229 \times 10^{3}$ | 31.27 | $3.93 \times 10^{4}$ | 3.917 |
| 2 | | 66.97 | $1.461 \times 10^{4}$ | 50.30 | $6.32 \times 10^{4}$ | 2.985 |
| 3 | | 99.98 | 2.169 | 93.80 | $1.179 \times 10^{5}$ | 3.215 |
| 4 | | 132.99 | 2.904 | 125.6 | $1.578 \times 10^{5}$ | 2.823 |
| 5 | | 165.9 | 3.566 | 154.2 | $1.938 \times 10^{5}$ | 3.158 |
| 6 | | 198.9 | 4.282 | 185.2 | $2.328 \times 10^{5}$ | 3.017 |
| 7 | | 231.9 | 4.981 | 215.4 | 2.707 | 3.235 |
| 8 | | 264.9 | 5.661 | 244.8 | 3.077 | 3.163 |
| 9 | | 297.9 | 6.286 | 271.9 | 3.416 | 3.312 |
| 10 | | 330.9 | 6.984 | 302.1 | 3.796 | 3.420 |
| 11 | | 363.9 | 7.597 | 328.6 | 4.128 | 3.445 |
| 12 | | 396.9 | 8.234 | 356.1 | 4.475 | 3.542 |
| 13 | | 429.9 | 8.993 | 389.0 | 4.888 | 3.767 |
| 14 | | 463.0 | 9.606 | 415.5 | 5.221 | 3.901 |
| 15 | | 496.0 | 10.292 | 445.2 | 5.594 | 4.001 |
| 16 | | 528.7 | 10.905 | 471.7 | 5.927 | 4.206 |
| 17 | | 561.4 | 11.615 | 502.4 | 6.313 | 4.329 |
| 1 | 4.2667 | | $7.351 \times 10^{3}$ | 31.80 | $3.996 \times 10^{3}$ | 4.001 |
| 2 | | ? | $1.507 \times 10^{4}$ | 65.18 | $8.191$ | 3.100 |
| 3 | | | $2.193 \times 10^{4}$ | 94.86 | $1.192 \times 10^{4}$ | 3.262 |
| 4 | | | 2.928 | 126.66 | 1.592 | 2.854 |
| 5 | | | 3.578 | 154.75 | 1.944 | 3.172 |
| 6 | | | 4.227 | 182.8 | 2.298 | 2.966 |
| 7 | | | 4.950 | 214.1 | 2.690 | 3.209 |
| 8 | | | 5.661 | 244.8 | 3.077 | 3.163 |
| 9 | | | 6.298 | 272.4 | 3.423 | 3.320 |
| 10 | | | 6.819 | 296.2 | 3.723 | 3.334 |
| 11 | | | 7.511 | 324.9 | 4.082 | 3.395 |
| 12 | | | 8.148 | 352.4 | 4.429 | 3.494 |
| 13 | | | 8.810 | 381.0 | 4.788 | 3.670 |
| 14 | | | 9.443 | 408.1 | 5.128 | 3.814 |
| 15 | | | 10.084 | 436.2 | 5.481 | 3.900 |
| 16 | | | 10.721 | 463.7 | 5.827 | 4.118 |
| 17 | | | 11.370 | 491.8 | 6.180 | 4.334 |

| Field coil | Current amperes | Magnetic power | Moment of coil + core | Intensity Moment + coil | Lines per sq. cm. | Susceptibility | Cast iron |
|---|---|---|---|---|---|---|---|
| 1 | | | 8.982×10 | 38.69 | 486.1 | | |
| 2 | | | 1.536×10² | 67.49 | 845.6 | | |
| 3 | | | 2.285×10 | 93.38 | 1178.5 | | |
| 4 | | | 2.934×10² | 126.91 | 1595. | | |
| 5 | | | 3.565 | 154.2 | 1932. | | |
| 6 | | | 4.288 | 185.5 | 2331. | | |
| 7 | | | 4.962 | 214.7 | 2697. | | |
| 8 | | | 5.697 | 246.4 | 3097. | | |
| 9 | | | 6.395 | 276.6 | 3476. | | |
| 10 | | | 6.996 | 302.6 | 3803 | | |
| 11 | | | 7.681 | 332.3 | 4175 | | |
| 12 | | | 8.232 | 356.1 | 4475 | | |
| 13 | | | 8.906 | 385.3 | 4842 | | |
| 14 | | | 9.382 | 405.9 | 5100 | | |
| 15 | | | 9.936 | 429.8 | 5400 | | |
| 16 | | | 10.029 | 433.6 | 5700 | | |
| 17 | | | 1.116 | 480.2 | 6030 | | |
| | | P.M. of 100 | lines 1 | sq. in. on | commencement of | | Cast wrought |
| 1 | | | 6398 | 27.29 | 343 | | |
| 2 | | | 13,230 | 57.23 | 719 | | |
| 3 | | | 19,720 | 85.30 | 1072 | | |
| 4 | | | 26,820 | 116.1 | 1458 | | |
| 5 | | | 34,300 | 148.4 | 1865 | | |
| 6 | | | 41,280 | 178.6 | 2240 | | |
| 7 | | | 47,530 | 205.6 | 2584 | | |
| 8 | | | 54,390 | 235.3 | 2957 | | |
| 9 | | | 60,520 | 261.8 | 3290 | | |
| 10 | | | 66,400 | 287.2 | 3610 | | |
| 11 | | | 72,648 | 314.2 | 3949 | | |
| 12 | | | 78,894 | 341.3 | 4289 | | |
| 13 | | | 84,892 | 367.3 | 4615 | | |
| 14 | | | 90,845 | 393.0 | 4938 | | |
| 15 | | | 97,260 | 420.7 | 5287 | | |
| 16 | | | 103,170 | 446.2 | 5609 | | |
| 17 | | | 109,470 | 473.8 | 5950 | | |

| Cycle No. | Current | Mag: factor | Moment | Intensity | Lines per sq. cm. | Inverse Intensity | (20) 5% Manganese |
|---|---|---|---|---|---|---|---|
| 1 | | | 7105 | 30.74 | 386.22 | | |
| 2 | | | 14945 | 64.64 | 812. | | |
| 3 | | | 20210 | 87.42 | 1099. | | |
| 4 | | | 26460 | 114.46 | 1438 | | |
| 5 | | | 32830 | 142.0 | 1785 | | |
| 6 | | | 39480 | 170.6 | 2145 | | |
| 7 | | | 45450 | 196.6 | 2470 | | |
| 8 | | | 52000 | 225.0 | 2827 | | |
| 9 | | | 57,578 | 249.1 | 3120 | | |
| 10 | | | 63,340 | 274.0 | 3443 | | |
| 11 | | | 69,340 | 300.0 | 3769 | | |
| 12 | | | 75,095 | 324.9 | 4080 | | |
| 13 | | | 80,360 | 347.6 | 4370 | | |
| 14 | | | 85,750 | 371.0 | 4665 | | |
| 15 | | | 91,030 | 393.8 | 4948 | | |
| 16 | | | 96,390 | 416.6 | 5234 | | |
| 17 | | | 107.69 | 439.8 | 5527 | | |
| | | | | | | | 10% Manganese |
| 1 | | | 3614 | 15.63 | 1964 | | |
| 2 | | | 6860 | 29.68 | 3730 | | |
| 3 | | | 9800 | 42.40 | 532.7 | | |
| 4 | | | 13,170 | 56.95 | 715.6 | | |
| 5 | | | 15,190 | 65.70 | 825.6 | | |
| 6 | | | 18,380 | 79.47 | 998.7 | | |
| 7 | | | 20,580 | 89.01 | 1119.0 | | |
| 8 | | | 22,783 | 98.53 | 1238.3 | | |
| 9 | | | 25,481 | 110.22 | 1385.0 | | |
| 10 | | | 26,710 | 115.5 | 1452 | | |
| 11 | | | 29,156 | 121.6 | 1528 | | |
| 12 | | | 30,870 | 133.5 | 1678 | | |
| 13 | | | 32,830 | 142.0 | 1785 | | |
| 14 | | | 34,670 | 150.0 | 1885 | | |
| 15 | | | 35.890 | 155.3 | 1951 | | |
| 16 | | | 37,240 | 161.1 | 2024 | | |
| 17 | | | 38,960 | 168.5 | 2118 | | |

## Friday 27th April

Ascertained by compass measurement (11.99) and by cathetometer (11.966) that the 12cm line on the bar of the portable magnetometer was too close to the centre of the circle by 0.034.

By repeated adjustment, succeeded in obtaining the centre of the vernier to be also closer to the centre of the circle than the centre of the magnet by 0.038, thus almost entirely annulling the error.

## Saturday 28th April

Obtained time at noon by wire from the W.V. office at Orange, recording the signals on the chronograph. The error of the clock appearing to be .21 secs. +.

# Monday 30th April

Work the following observations of the value of H on the 4th pier, after removing iron from the immediate vicinity — with the Gauss instrument.




Torsion Reading small magnet.

$$\left.\begin{array}{l} \overset{\text{Pl. 1}}{+} = 0.\cancel{29}\,28 \\ \overset{\text{Pl. 2}}{-} = 0.29\,\cancel{28} \end{array}\right\} 0.27$$

Mean $-0.27 \pm 0.$ s.d.

Dist: of scale 289.5.

| Magnet on | | Pl. from | Obs. | |
|---|---|---|---|---|
| | a | N | − 11.59 | ~~11.595 +~~ |
| | b | S | − 28.27 | ~~28.327 +~~ |
| | c | N | − 28.34 | ~~28.34 +~~ |
| | d | N | − 11.69 | |
| | c | N | − 28.34 | |
| | b | S | − 28.28 | |
| | a | S | − 11.60 | |
| | a | N | + 11.66 | |
| | b | N | + 28.41 | |
| | c | S | + 28.30 | |
| | d | S | + 11.61 | |
| | c | S | + 28.28 | |
| | b | N | + 28.405 | |
| | a | N | + 11.69 | |
| | a | S | − 11.535 ? | rejected |
| | b | S | − 28.22 ? | rejected |
| | c | N | − 28.33 | |
| | d | N | − 11.69 | |
| | c | N | − 28.325 | |
| | b | S | − 28.30 | |
| | d | S | − 11.605 | |

Zero correct.

Magnet on

| a | d | b | c |
|---|---|---|---|
| − 11.59 | − 11.69 | − 28.27 | − 28.34 |
| − 11.60 | + 11.61 | − 28.28 | − 28.34 |
| + 11.66 | − 11.69 | + 28.41 | + 28.30 |
| + 11.69 | | + 28.405 | + 28.28 |
| − 11.605 | | − 29.30 | − 28.33 |
| | | | − 28.325 |
| 11.629 | 11.663 | 28.335 | 28.319 |

11.646 28.327

Scale distant 289.5.

# Vibrating Times.

Magnet swinging by its own fiber.

Torsion $\frac{\pi}{2}$ + 0·101
$\frac{\pi}{2}$ − 0·099 } 0·100 s.d. Distance 289·9.

238 complete vibs. of magnet in 2713·87"
or 11·4028" per vib.
amplitudes 4·2 —— 1·0 s.d.

Magnet loaded with brass ring weighing 167·279 and whose moment of inertia = 1087·31 cm. gms. Suspended by 5 fibers both fresh suspension, old one breaking.

Torsion readings

$\frac{\pi}{2}$ + 2·39
$\frac{\pi}{2}$ − 2·89 } Mean 2·595 s.d. Distance 289·9

10½ swings completed in 2588 secs or the period of one double vib = 24·8846"
amplitude 16 —— 10 s.d. Distance 289·9.
Temp 22°C.

The corrected time of oscillation for the unloaded magnet is

$\sqrt{\frac{5400+v}{5400}} \times (11.4028)^2$ $\therefore t^2 = \frac{5400+v}{5400}(11.4028)^2$

where $v = \tan^{-1}\frac{0.1}{289.9} = \tan^{-1} 0.000345 = 1'$

$\frac{5401}{5400} \times 11.4028^2$

log 11·4028 = 1·0570115
1·0570115
5401 = 3·7324742
5·8146 4772
5400 = 3·7323439
$t^2$ = 130·0148 2·1141031

The corrected time of oscillation for the loaded magnet is

$\sqrt{\frac{5400+v}{5400}}(24.8846)^2$ where $v = \tan^{-1}\frac{2.595}{289.9} = 0.00895 = 31$

$\frac{5431}{5400} \times 619.2433 = 622.7978$

The moment of Inertia of the magnet is thus

$$\frac{130 \cdot 0148}{622 \cdot 799 - 130 \cdot 0148} \times 1087 \cdot 31$$

$$= \frac{130 \cdot 0148 \times 1087 \cdot 31}{492 \cdot 75} = 286 \cdot 96$$

The time of ~~oscillation~~ oscillation being $\sqrt{130 \cdot 0148}$

$$MH = \frac{4\pi^2 \times 286 \cdot 96}{130 \cdot 0148}$$

$$= \frac{4 \times 9 \cdot 8696 \times 286 \cdot 96}{130 \cdot 0148}$$

$$87 \cdot 112$$

$\log 4 = 0 \cdot 6020600$
$\pi^2 = 0 \cdot 9942997$
$286 \cdot 96 = 2 \cdot 4578211$
$2 \cdot 0561811$
$130 \cdot 0148 = 2 \cdot 1141103$
$1 \cdot 9400708$

The corrected deflections are

$$\frac{5400 + v}{5400} \times 11 \cdot 646 \quad \text{and} \quad \frac{5400 + v}{5400} \times 28 \cdot 327$$

where $v = \tan^{-1} \frac{0 \cdot 27}{289 \cdot 5} = \frac{27 \times 10^{-4}}{2 \cdot 895} = 9 \cdot 326 \times 10^{-4} = \cdot 0009326 = 3''$

$11 \cdot 646 \left(\frac{5403}{5400}\right)$

$28 \cdot 327 \left(\frac{5403}{5400}\right)$

$\log 5403 = 3 \cdot 7326350$
$5400 = 3 \cdot 7323938$
$0 \cdot 0002412$
$- 11 \cdot 646 = 1 \cdot 0661768$
$1 \cdot 0664180 = 11 \cdot 6525$
$- 28 \cdot 327 = 1 \cdot 4522286$
$0 \cdot 0002412$
$1 \cdot 4524418 = 28 \cdot 3413$

$$\tan^{-1} \frac{11 \cdot 653}{289 \cdot 9} = \frac{11 \cdot 653}{2 \cdot 899} \times 10^{-2} = 0 \cdot 040197 = 2^\circ 18' = 0 \cdot 04013 \text{ Rad.}$$

$$\tan^{-1} \frac{28 \cdot 3413}{289 \cdot 9} = 0 \cdot 097768 = 5^\circ 35' \; 0 \cdot 09729$$

$R_1 = 50$
$R_2 = 37 \cdot 5$

$$R = \frac{\left(\frac{50}{2}\right)^3 \times 0 \cdot 04013 - \left(\frac{37 \cdot 5}{2}\right)^3 0 \cdot 09729}{25 \times 0 \cdot 04013 - \frac{37 \cdot 5}{2} 0 \cdot 09729}$$

$$\frac{125 \cdot 000 \times 0 \cdot 04013 - 527 \cdot 3414 \times 0 \cdot 09729}{25 \times \cdot 04013 - 18 \cdot 750 \times 0 \cdot 09729}$$

$$= \frac{5 \cdot 12875 - 41 \cdot 30530}{1 \cdot 00325 - 1 \cdot 82419} = \frac{36 \cdot 17655}{0 \cdot 82094} = \frac{44 \cdot 066}{2}$$

$$= 22 \cdot 033$$

$$\frac{M}{H} = 62{,}500 \times 0{\cdot}040013 \times \frac{2477{\cdot}967}{2500}$$

$$= 2486{\cdot}02$$

$$MH = 87{\cdot}112$$

log 2486·02 = 3·39550146
2·66777971 = 465·36 M
1·94000777 = 87·112 MH
T·27222866 = 0·1872 H

log = 1·94000777

(more correctly) =

$$\frac{\left(\frac{50}{2}\right)^3 \times 0{\cdot}040197 - \left(\frac{37{\cdot}5}{2}\right)^3 \times 0{\cdot}097768}{\frac{50}{2} \times 0{\cdot}040197 - \frac{37{\cdot}5}{2} \times 0{\cdot}097768}$$

$$= \frac{2512{\cdot}3125 - 2575{\cdot}2305}{1{\cdot}004925 - 1{\cdot}83315} = \frac{62{\cdot}92}{0{\cdot}828225}$$

$$= 75{\cdot}97$$

$$\frac{M}{H} = 62{,}500 \times 0{\cdot}040197 \times \frac{24224{\cdot}03}{2500}$$

$$= 2512{\cdot}3125 \times 4 \times 0{\cdot}2422403$$

$$= 10044925 \times 0{\cdot}2422403$$

$$= 2436$$

log 2436 = 3·3866773
87·112 = 1·94000780
2·66677993 = 1460·6
MH 1·94000780
T·27677004 = 0·1894 H

The strength of the magnet pole = 40·4
Intensity of Magnetisation 131·6
Lines to sq. cm. 1650.
Volume approximately 35·
Length 11·4
Breadth 1·12
Thickness 0·28.
Moment 460·6

Tuesday 1st May

following measurement for H at the 14th pair was taken with the small portable magnetometer. The swinging magnet consists of a tube of 3.3 × 1.15 inner diam 0.80. Its weight being 13.55.

The moment of inertia referred to a line perp: to axis is

$$13.55\left(\frac{(3.3)^2}{12}+\frac{(1.40)^2+(0.58)^2}{4}\right)$$

$$13.55\left(\frac{10.89}{12}+\frac{0.16+0.3306}{4}\right)$$

$$13.55\left(\frac{10.89}{12}+\frac{0.4906}{4}\right)$$

$$13.55\left(\frac{10.89}{12}+\frac{1.4718}{12}\right)$$

$$13.55\left(\frac{12.3618}{12}\right)$$

$$13.55 \times 1.03015 = 13.959 \text{ cm}^2 \text{ gms.}$$

The cylinder was loaded by a small brass rod 0.823 diam × 3.587 l. and 16.039g. Its moment about a line perp: to the axis

$$= 16.039g \times\left\{\frac{(3.587)^2}{12}+\frac{(0.4115)^2}{4}\right\}$$

$$16.039g \times (1.0722 + 0.04223)$$

$$16.039g \times 1.1145 = 17.876 \text{ cm}^2 \text{ gms.}$$

The periodic time of the unloaded needle was determined by chronograph to be 5.0665 but the torsion produced by $\frac{1}{2}$ was $\tan^{-1}\frac{0.265}{215.9} = .0012$ so that the correction is thus

$$\sqrt{t^2\left(1-\frac{4}{5400}\right)} = t\left(1-\frac{2}{5400}\right) = t(1-0.00037)$$

$$= 5.0665 \times 0.99963 = 5.0646$$

log 5.0665 = 0.7047080
0.7047080
5396 3.7320719
2.1412879
5400 4.7323959
$t^2$ 25.65 = 1.4099921
5.0665 = 0.7047080

The periodic time of the bonded magnet was by chronograph 7.585

and the torsion due to $\frac{1}{2}$ was 0.33 or $\tan^{-1}\frac{0.33}{2159}$

$= 0.00152 = 5'$

log) ·33 = 7.518518
− ) 2159 = 3342526
·1842613 = 0°5'

and the corrected time =

$\left(\frac{5395}{5400}\right)^2 = \frac{57.5322 \times 5395}{5400}$

log 5395 = ·7319914
log 7.585 = 0.8799556
0.8799556
·4919024
·5322938
− 5'

$= 5.7479$

corrected $t^{m} = 57.4789 = 7.595086$

The moment of inertia of the magnet

$= 17.876 \left(\frac{57.4789 - 25.6502}{57.4789}\right)$

log) 17.876 = 1.2522703
25.6502 = 1.4099941
2.661 3644
21.8287 1.3390338
1.3223306
= 21.005 cm²gm

$\frac{17.876 \times 25.6502}{21.8287} = 21.0051$

$M H = \frac{4 \times \pi^2 \times 21.005}{25.6502} =$

$\frac{39.47842 \times 21.005}{25.6502} = \frac{829244}{25.6502}$

$= 32.3289$

log $\pi^2$ = 9942997
− 4 = 6020600
3223306
9186903
·25602 4099941
32.3289 = 5095962

## Deflections



N pole in a = 18.05 φ = 12°54.45
S - - b = 22.09 φ' = 6°36.30

S pole in a = 17.99 φ = 12°57.45
N - - b = 21.93 φ' = 6°36.30

Mean a = 18.02 Mean b = 22.01

$M = \frac{(18.02)^3}{2} \tan 12°57.45 - \frac{(22.01)^3}{2} \tan 6°36.30$

$9.01 \tan 12°57.45 - 11.005 \tan 6°36.30$

$29,257.3 \times 0.22842 - 53,126 \times 0.115851$

$2.05806 - 1.27494$

$\frac{6681 - 6,176.3}{0.78312} = \frac{505}{0.7831} = 64.5$

log 18·02 = 1·255754 8
1·255754 8
1·255754 8
9·35886 0
3·125586 46
0·3070300
2·8248316 6

668·1
617·6
50·5

log 22·01 = 1·3426200
1·3426200
1·3426200
4·06390
13·09176
0·3070 3
2·79076 = 617·6

log 9·01 = 0·9547248
9·35860
19·31332 48 = 2·058
1·275
0·783

log 50·5 = 1·7032911 6
− 783 1·8923732
2·8046182 = 63·6g

log. 11·0505 = 1·04159
9·06390
0·1054 = 1·275

The torsion of $\frac{\pi}{3}$ produces a deviation of $\tan^{-1}\frac{1·16}{253·25}$
= 0·0045 8 = 16″.

Correction = $\frac{54·46}{54·00} \times 12·8625'$ log tan 12·8625′ = 9·35860
0·001285
log 54·16 = 0·7336787 12·25′ 9·359885
54 = 0·7323938
0·0012849 9·36390
0·001285
6·38′ 9·06210 85

$$\frac{M}{H} = \frac{1}{2}\left(18·02\right)^3 \tan\left(2·54'\left(1 - \frac{63·7}{\cancel{324·7}\ (18·02)}\right)\right)$$

$$\frac{2926 \times 0·229064 \times 324·7 - 63·7}{324·7}$$

$$= \frac{670·47 \times 261}{324·7} = 538·7$$

$$\frac{M}{H} = \frac{1}{2}\left(22·01\right)^3 \tan 6°38' \left(1 - \frac{63·7}{22·01^2}\right)$$

$$= \frac{5331 \times 0·11629 \times 4844·4 - 63·7}{4844·4}$$

$$= 538·4.$$

log. MH = 1·5095962

$\frac{M}{H}$ = 2·7311857

4·2407819

M 2·1203909 = 131·9

MH 1·5095962

1·3892053 = 0·245

Particulars of magnet dimensions by Kathetometer

| | | | |
|---|---|---|---|
| Length of cylinder | 3·305 | | |
| External Diameter | 1·158 | Radius | 0·579 |
| Internal Diameter | 0·820 | " | 0·410 |
| Length of Collar | 0·395 | | |
| External Diameter | 1·397 | " | 0·6985 |
| Internal " | 1·168 | " | 0·584 |

The moment of inertia =

$$13\cdot55\left(\frac{(3\cdot305)^2}{12}+\frac{0\cdot579^2+0\cdot41^2}{4}\right)+1\cdot592\left(\frac{0\cdot395^2}{12}+\frac{0\cdot698^2+0\cdot584^2}{4}\right)$$

$$= 14\cdot037 + 0\cdot215 = 14\cdot252.$$

Accepting this value we have

$$MH = \frac{4\pi^2 \times 14\cdot252}{25\cdot6502} = \frac{39\cdot478442 \times 14\cdot252}{25\cdot6502}.$$

log = 21·935 = 1·3411376

$\frac{M}{H}$ 2·7311857

$M^2$ 4·0723233

M 2·0361617

MH 1·3411376

1·3049789 = 0·2015

0·5 secs. of lost changed rate 10 secs. daily.

# Clock Records.

| Date | Clock error | Error | Diff. | Days | Rate | Watch error | Diff | Days | Rate |
|---|---|---|---|---|---|---|---|---|---|
| S 25 | 21 + | | | | | 13 — | | | |
| T 26 | 13 — | | 34 — | 3 | —11 | 22 — | 9 — | 3 | 3 — |
| W 27 | 22·7 + | | 35·7 + | 2 | 17·9 + | 28 — | 6 — | 2 | 3 — |
| Th 28 | 33·5 — | Clock adjusted | | | | 37 — | 9 — | 1 | 9 — |
| S 5 | 20·3 — | | 12·2 + | 7 | 12·2 + | | | | |
| M 7 | 7·5 + | | 27·8 + | 2 | 13·9 + | 40 — | 3 — | 3 | 1 — |
| T 8 | 12·7 + | | 5·2 + | 1 | 5·2 + | | | | |
| W 9 | 30 + | | 17·3 + | 1 | 17·3 + | 50 — | 10 — | 2 | 5 — |
| F 11 | 40·3 + | Adjusted 8 min. down | 10·5 + | 1 | 10·5 + | 63 — | 13 — | 1 | 13 — |
| S 12 | 53·5 + | | 17 + | 2 | 8·5 + | | | | |
| M 14 | 8 + | | 45·5 — | 2 | 22·8 — | | | | |
| T 15 | 16 — | | 24 — | 2 | 12 — | 50 — | 13 + | 6 | 2 + |
| W 16 | 22 — | Adjusted 8 min. down | 63 — | 1 | 63 — | 47 — | 3 + | 1 | 3 + |
| F 18 | 66·8 — | | 44·5 — | 1 | 44·5 — | 53 — | 6 — | 1 | 6 — |
| S 19 | 72·3 — | | 5·5 — | 1 | 5·5 — | 55 — | 2 — | 1 | 2 — |
| M 21 | 81·5 — | | 9·2 — | 2 | 4·6 — | | | | |
| T 22 | 109·0 — | Adjusted 1 minute | 20·5 — | 1 | 20·5 — | | | | |
| W 23 | 82·7 — | Adjusted | 53·3 — | 1 | — | 60 — | 5 — | 4 | 1·2 — |
| F 25 | 85·5 — | | 62·8 — | 1 | 62·8 — | 63 — | 3 — | 1 | 3 — |
| S 26 | 68·0 — | Adjusted | 17·5 + | 1 | 17·5 + | 56 — | 7 + | 1 | 7 + |
| M 28 | 30·0 — | | | | | | | | |
| W 30 | 2 — | | 48 + | 1 | 48 + | | | | |
| | Took down clock and relevelled plate. | | | | | | | | |
| F 1 6.88 | 60 + | | 0 | | | 50 — | | | |
| S 2 6.88 | 73·8 + | 13·8 | 13·8 + | 1 | 13·8 + | | | | |
| M 4 6.88 | 109·4 + 24·4 | 24 fast 24 h | 36·6 + | 2 | 17·3 + | 68 — | 18 — | 2 | 9 — |
| | 49 + | | | | | | | | |
| T 5 6.88 | 54 + 60 | Set back | 5 + | 1 | 5 + | 68 — | | | |
| | 6 — | | | | | | | | |
| Th 6 6.88 | Run down 9·25 + | | | | | | | | |
| F 7 6.88 | 17·25 + | | 9·0 + | 1 | 9 + | 66 — | 1·0 — | 3 | 0·3 — |
| S 9 | 16·5 + | | | | | | | | |
| M 11 | 22 + | | | | | | | | |
| T 12 | 27 + | | | | | | | | |
| F 15 6.88 | 26 + | | 8·75 + | 8 | 1·46 + | | | | |
| M 18 6.88 | 15 + | | 11 — | 3 | 3·7 — | 52 — | 14 — | 10 | 1·4 — |
| T 19 6.88 | 29·2 + | | 2·2 + | 6 | 0·4 + | 47 — | | | |

Thursday 2nd May

Adjusted Clock so that the second hand reaches zero just about the moment the clock sends its minute signal so that the second mark following the minute signal at noon may be taken as clock noon.

The following may be taken as a resumé of the results obtained with the different specimens of iron

| Ampere turns | Norway Iron | Plate Iron | Cast Iron | Cast wrought Iron | 5% Manganese | 10% Manganese | Paraffin + Iron filings |
|---|---|---|---|---|---|---|---|
| 5000 | 100% | 96.7 | 92.9 | 91.9 | 86.6 | 32.3 | 40.5 |
| 10000 | 100% | 98.2 | 83.3 | 85.5 | 75.2 | 27.7 | 31.6 |
| 15,000 | 100% | 99.0 | 78.9 | 83.0 | 69.9 | 28.8 | 29.2 |

# Friday 4th May.

Took errors of Voltmeters as follows

| | | | Error on 8th March |
|---|---|---|---|
| A. + P. | 120 volts | indicates | 3.6 + |
| A + P | 150 | " | 4.2 + |
| Res: Cox | Hartmann & Braun | " | 0.6 + |
| Door | " | " | 3.25 + |
| Portable | " | " | 3.7 + |

Tests of a certain specimen of insulated wire from Schenectady in water.

From immersion 2/5/98 noon at 10v poly: to 50v
" " 3/5/ " " 100v " 200v

Took down the meters and after washing the plate in distilled water dried and weighed them.

| No. | Weight Mar. 31st | Weight 4th May | Gain | Loss | |
|---|---|---|---|---|---|
| 1 | 23.704 | c 24.240 | 0.536 | | |
| 2 | 24.542 | a 24.007 | | 0.535 | |
| 3 | 23.738 | a 23.193 | ~~0.535~~ | 0.5435 | |
| 4 | 24.218 | c 24.750 | 0.532 | ~~0.532~~ | |
| 5 | 24.164 | c 24.715 | 0.551 | | |
| 6 | 24.432 | a 23.898 | | 0.534 | |
| 7 | 24.853 | a 24.327 | 0. | 0.526 | |
| 8 | 24.380 | c 24.902 | 0.522 | | |
| 9 | 24.427 | a 23.914 | | 0.513 | |
| 10 | 24.130 | c 24.693 | 0.563 | | |
| 11 | 24.190 | a 23.644 | | 0.546 | |
| 12 | 24.057 | c 24.642 | 0.5855 | | |
| 13 | 23.799 | a 23.258 | | 0.541 | |
| 14 | 24.506 | c 25.059 | 0.553 | | |
| 15 | 24.825 | a 24.278 | | 0.547 | |
| 16 | 24.059 | c 24.565 | 0.506 | | |
| 17 | 24.018 | a 23.479 | | 0.539 | |
| 18 | 23.234 | c 23.827 | 0.597 | | |
| 19 | 24.358 | a 24.896 | | 0.538 | |
| 20 | 24.061 | c 23.520 | 0.541 | | |
| | | m | | 0.53625 | |

## Exposure Experiments

33 Gravity cells having an assumed EMF of 36·3 volts and a measured I. R. of 14·0 ω were connected with the rheostatic bridge whose arms were $\frac{1000}{100}$ & $\frac{R}{E}$. To obtain 20 mas. the res. thrown in the battery circuit was $\frac{900 \times 36{\cdot}3}{20} - (140+90) - \frac{100}{11}$

$$:= 1650 - 230 - 14{\cdot}20 -$$

A number of plates made of different metals had been prepared approx. 1" sq. and 0·05" thick. One side of these plates was coated with shellac and an insulated copper wire ~~to~~ soldered to a side lug. The plates thus offered a little more than 1 sq. in. surface.

The cell was a battery jar 21 cms high × 15 cms in diameter. It was coated inside with a strip of copper sheet 15 cms high and reaching all round. A terminal on a raised strip of this formed the anode. The cell was then filled with distilled water up to the level of the strip top and salt (100 grms) added. This was all done by 18 o'clock.

At 20 o'clock the readings were taken. 20 milliamperes assumed to be passing. The exposures which were laid horizontal about 1 cm. below surface. Reading taken to immediate f.x.

| | | | |
|---|---|---|---|
| Copper plate | 15 ω | 14·08 ω in cct. | 5 |
| Silver | 12·9 ω | | (6) |
| Zinc | 7·6 ω | | 4 |
| Aluminium | 6·5 ω | | (3) |
| Zinc repeated with poly. | 6·8 ω | | (7) |
| Copper | 15·7 ω | | (8) |
| Tin | 12·3 ω | | (5) |
| Iron | 9·9 ω | | (4) |
| Lead | 6·6 ω | reducing to 5·9 ω | (1) |
| Nickel | 34 ω | | |
| 2nd Plate Nickel | 33·5 ω | (33·3) | (9) |

The Constants of the various Galvanometers were calculated as follows:—

Obach Tangent 0·181 ohm: scale for 1 amp.
Ring " 0·137 or 7°·47′ per amp.
Gaugain " 1·3442 53°·21′ " "

S. Dynamometer thin coil. $0.857 \times \sqrt{\text{Tmin degrees}}$
Ayrton & Perry Ammeter 1 amp: indicated at 14·227
Long Ammeter indicates 0·5 when 5·13 cms from centre of ring or 9·75 on scale

Tested .5 meter boxes for electrical connexion as follows. 33 Gravities working thro the 5 meter in series direct, about $\frac{36}{1440}$ or 0·25 ampere flowing. The following deflections were obtained with the 5th bobbin galvr: and 2000 ω in its circuit acting as a shunt.

| | | check | Res. of coil |
|---|---|---|---|
| bobbin no 1. | 547 divs: | | 32·325ω |
| " " 2 | 546 " | 546 | 32·425ω |
| " " 3 | 546·5 " | 547 | 32·285ω |
| " " 4 | 548 " | 547 | 32·175ω |
| " " 5 | 548 " | | 32·335ω |
| " " 6 | 548·5 " | | 32·315ω |
| " " 7 | 549 " | | 32·495ω |
| " " 8 | 549 " | | 32·365ω |
| " " 9 | 550 " | | 32·175ω |
| " " 10 | 550 " | | 32·205ω |

Temp. of Bridge 18·7° Room 16°

Res: of each cells shunt 0·04 ω.

Res: of a certain piece of stubb's steel 0·0063ω between points nearly ½" from ends, including res: of contact. $\frac{87}{500} \times 0.04 = 0.0063$.

The maximum divergence is thus

$\frac{550-546}{550} \times 100 = \% = \frac{400}{550} = 0.7\%$

Current passing thro meter bobbin $= \frac{0.04}{32.2+2+0.04}$ say $\frac{0.04}{34}$ or $\frac{1}{850}$

$\frac{430}{114.75} = 3.7473$ $\log_{10} 3.7473 = 0.5736837$

$- M = \bar{1}.6377843$

$0.9358993 = 8.628$

$\log 0.5736837 = \bar{1}.7510326$

$M = \bar{1}.6377843$

$20 \overline{) 0.1132483}$

$1.3010300$

$\bar{1}.8122183 = .06496$

$\frac{473}{125.5} - 3.7689$ $\log 3.7689 = 0.5762146 = \bar{1}.7605846$

$M \times 20 = 0.9388143$

$.8217703$



## Monday 7th May.

Recommenced magnetic induction experiments.
Following is recapitulation of conditions:—

Diam of iron cores 7.7 ~~Area~~ Radius (mean) 3.85
Mean area ~~181298~~ 46.566 sq. cms. Length.
Diam. of conductor 0.065" = 0.165 cms. rad = 0.0825 cm
Length of cores 40.7.
Distance (perpendicular) between axes. 32.7.
Yoke 7.4 × 7.4 = 54.76 sq. cms.
Pole piece 7.4 × 7.4.
Length of closed mag: cct. = 2(32.7 + 40.7) = 146.8

No. of turns of Rt hand from yoke 1057
- - - Lt - - - 848 1905.

Took $\lambda$ as follows.

10 Complete swings in 347.35 secs by chronograph T = 34.735

1st semicirc 430, 21st - 114.75 } $\lambda = \frac{1}{20}\log_e \frac{430}{114.75} = 0.06490$ $1+\frac{\lambda}{2} = 1.03245$

$T \times (1+\frac{\lambda}{2}) = 35.862$

10 Complete swings in 347.83 sec by chrono T = 34.783

1st semicirc 473, 21st - 125.5 } $\lambda = \frac{1}{20}\log_e \frac{473}{125.5} = 0.06634$ $1+\frac{\lambda}{2} = 1.03317$

$T(1+\frac{\lambda}{2}) = 35.936$

1 C. C. @ 17° C = 1.436 volts gives disch of 125 thro 0.5
$= 0.718 \times 10^{-15}$ qs. Mean $(1+\frac{\lambda}{2})T = 35.911 \times 125 = 4488.9$

$\frac{0.718}{T(1+\frac{\lambda}{2})\theta} = 1.600 \times 10^{-4}$. — Const: of conversion to Microc

Res. of ballistic Galvr. 5192ω @ temp 18.5° C.
- - connections + moving wire 2.5ω.
- - magnet coils cold 4.72ω.

$S = 54.75$

| | d | $\frac{d}{S}$ | d | $\frac{d}{S}$ |
|---|---|---|---|---|
| d = | 0.5 | 0.009132 | 5.0 | 0.09132 |
| = | 0.75 | 0.01370 | 6.0 | 0.10958 |
| = | 1.0 | 0.01826 | 7.0 | 0.12785 |
| = | 1.5 | 0.02740 | 8.0 | 0.14612 |
| = | 2.0 | 0.03653 | 9.0 | |
| = | 2.5 | 0.04566 | 10.0 | |
| = | 3.0 | 0.05479 | | |
| = | 4.0 | 0.07306 | | |

S here assumed to be polar surface.

| Time | Volts | Ohms added | 7 cells on Pots | 0·5 cells current | Interp. Diff. Amperes = Volts | Temp. 18°C | Unit tube a microcoulombs |
|---|---|---|---|---|---|---|---|
| 10·24 | – | – | – | 0 | 0·20 | 7·5 | |
| ·33 | | | | | | 7·25 | 0·041 |
| ·43 | | | | | | 6·75 | 7·17 |
| 1·07 | 114·7 | 3 Temp. = 2·46 | 0·1 Ent. | 0·1 | 190 | 8·5 | 2·13600 |
| ·10 | 114·6 | " | | | 238·5 | 9·7 | 0·0572 |
| ·18 | 113·6 | - | | | 2,534·40 | 10. | 2·8000 |
| ·24 | 113·7 | | 0·2 | 0·2 | 381 | 23·3 | 6·01 |
| ·30 | 113·8 | 55·7 | | - | | 23. | 0·131 |
| ·37 | 114·14 | | | | 478·8 | 21·65 | 23·45 |
| ·42 | 113·2 | | 0·4 | 0·4 | 4,478·92 | 47·25 | 6·7020 |
| ·45 | 113·7 | 273 | | | 762 | 49·25 | 18·58 |
| ·50 | 114· | | | | 8,557·6 | 48. | 0·277 |
| 12·09 | 114·9 | 110·2 | 7°·45' | 1·0 | 10,768 | | 14·5,000 |
| ·17 | 113·5 | | 7°·47' | - | 1905 | 113 | 2·793 |
| ·37 | 113·6 | 72·4 | 11°·36' | 1·5 | 23,904 | 112·75 | 0·644 |
| ·43 | 113·14 | | " | | 2237 | 150·5 | 7·26 |
| ·46 | 113·7 | | - | | 3500 | 114·6 | 0·864 |
| 14·01 | 113·1 | 52·58 | 15°·17' | 2·0 | 33,400 | 158·70 | 14·8000 |
| ·07 | 113·3 | | - | | 3810 | 172. | 7·28 |
| ·15 | 112·25 | | | | 47,88 | 172·75 | 0·988 |
| ·27 | 112·8 | 40·45 | 18°·52' | 2·5 | 47,900 | 171 | 5·12300 |
| ·31 | 113·3 | | - | | 4762 | 182 | 11·000 |
| ·38 | 112·14 | | " | | 57,814 | 182 | 1·014·9 |
| ·48 | 112·5 | 32·4 | 22°·18' | 3·0 | 5715 | 183·4 | 5·13000 |
| ·54 | 112·2 | | - | | | 191 | 11·680 |
| 15·09 | 113·3 | | | | 71,524 | 191·9 | 1·099 |
| ·10 | 112·1 | 28·96 | 27°·50' | 4·0 | 66,827 | 191 | 5·9,300 |
| ·15 | 112·5 | | 28°·50 | | 7620 | 198·5 | 15,225 |
| ·22 | 112·7 | | 28°·20' | | 85,76 | 197·7 | 1·141 |
| ·37 | 112·8 | 19·94 | 34°·20' | 5·0 | 99,280 | 199·5 | 5·91600 |
| ·41 | 112·4 | | " | | 9225 | 202·2 | 12,703 |
| ·45 | 112·5 | | 33°·50' | | | 202·75 | |
| ·50 | 112·5 | | 33°·40' | | 11969 | 200·25 | 1·165 |
| 16·03 | 111·5 | 16·4 | 39°·20' | 6·0 | 11,496 | 201·0 | 6·01400 |
| ·09 | 112·1 | | " | - | 11,420 | 210·75 | 13,970 |
| ·15 | 112·3 | | - | - | 11,363 | 210·5 | 1·212 |
| ·17 | 113·2 | | 39°·10' | - | 1,337,650 | 212·4 | 6·21400 |
| ·25 | 112·1 | 12·4 | 43°·45' | 7·0 | 13,335 | 210 | 13,490 |
| ·27 | 112·2 | | 43°·20' | - | 16757 | 215·75 | 1·244 |
| ·35 | 112·2 | | 43°·30' | - | 1,566,610 | 215·6 | 6·45000 |
| ·42 | 111·2 | 9·6 | 47°·20 | 8·0 | 15,260 | 218. | 13,800 |
| 17·25 | 111·1 | | 46°·20 | | 1,8,151,4 | 227·75 | 1·258 |
| ·38 | 111·3 | 7·5 | 50°·45' | 9·0 | 17,165 | 220. | 6·23,300 |
| ·41 | 111·14 | | - | | 2,154·5 | 222 | 14,000 |
| ·48 | 111·8 | 6·3 | 53°·40' | 10·0 | 19,872 | 221·5 | 1·273 |
| | | | | | 2,4,0,3 | 222·8 | 6·6,000 |
| | | | | | 2,320,482 | | 1·230 |
| | | | | | 2,320,482 | | 6·2,000 |

*The curve dist:* Interpolation indicated in 0·38 dist: curve each at 8 amp. at half angle at 0·5 amp. but although allowance had been made Equilibrium had not been reached. Survey 7°.

Tuesday 8th May

Res: between 2 iron rails buried in the ground at a depth of 2 feet. = 270 ω
Res: of one rail 0·09 ω

Following cells made up. Daniels type.

| | | |
|---|---|---|
| No 1. | $FeO_4$ and solution of | $NH_4Cl$ |
| - 2. | Cu | |
| - 3 | $FeO$ | $KHO$ 30% |
| - 4 | antimony oxide common | |
| - 5 | Cobalt | |

Set the above to work about 11·30 on 7th.

| | E M F | P.D. | C. | I.R. |
|---|---|---|---|---|
| No 1. | 0·386 | 0·242 | 0·726 | 0·20 |
| - 2 | 0·592 | 0·527 | 1·581 | 0·040 |
| - 3 | 0·720 | 0·507 | 1·521 | 0·00 |
| - 4 | 0·368 | 0·282 | 0·846 | 0·00 |
| - 5 | 0·382 | 0·320 | 0·960 | 0·07 |

Set up two more

No. 6. White oxide of antimony + $KHO$ 30% + $NH_4Cl$ sat.
- 7 - - - -

15 o'clock

| | | | |
|---|---|---|---|
| No 1. | 0·192 | 0·144 | 0·432 |
| - 2 | 0·474 | 0·410 | 1·230 |
| - 3 | 0·740 | 0·426 | 1·278 |
| - 4 | 0·280 | 0·242 | 0·726 |
| - 5 | 0·305 | 0·248 | 0·744 |
| - 6 | 0·712 | 0·478 | 1·434 |
| - 7 | 0·604 | 0·316 | 0·948 |

17 o'clock

| | | | |
|---|---|---|---|
| No 1 | 0·168 | 0·120 | 0·360 |
| - 2 | 0·468 | 0·404 | 1·212 |
| - 3 | 0·394 | 0·394 | 1·182 |
| - 4 | 0·300 | 0·240 | 0·720 |
| - 5 | 0·304 | 0·254 | 0·762 |
| - 6 | 0·472 | 0·344 | 1·032 |
| - 7 | 0·585 | 0·374 | 1·082 |

Set 4 sets of 5 Daniels cells to work on 1·4 ω each at 14 o'clock. Removed not.

$\log_{\frac{1}{2}} 3.8097 = 0.5808908 = \bar{1}.7640946$

$\quad 0.9388143$

$\quad \bar{2}.8252803 \quad .066578$

$3.8644 = 0.5870321 = \bar{1}.7686995$

$\quad 0.9388143$

$\quad \bar{2}.8298852 = 0.6759$

The Area of iron in the coils $S = 46.57$. $\frac{1}{S} = 0.021473$

| $d$ | $\frac{d}{S}$ |
|---|---|
| 0.5 | 0.010737 |
| 0.75 | 0.016105 |
| 1.0 | 0.021473 |
| 1.5 | 0.032210 |
| 2. | 0.042946 |
| 2.5 | 0.053683 |
| 3. | 0.064420 |
| 4 | 0.085892 |
| 5 | 0.107365 |
| 6 | 0.128838 |
| 7 | 0.150311 |
| 8 | 0.171784 |



## Pendulum Observations.

$\lambda$.

10 Complete vibs in 349.15 secs. $T = 34.915$

$\lambda = \frac{1}{20}\log_e \frac{4090.5}{128.79} = \frac{1}{20}\log_e 3.8097 = 0.06488\ 1+\frac{1}{2} = 1.033439$

$34.915 \times 1.033439 = 36.083.$

10 Complete vibs in 348.7 secs $T = 34.87$

$\lambda = \frac{1}{20}\log_e \frac{456}{118} = \frac{1}{20}\log_e 3.86444 = 0.06759\ 1+\frac{1}{2} = 1.03388$

$34.87 \times 1.03388 = 36.051.$

Mean $T(1+\frac{1}{2}) = 36.067. \times 1.6 \times 10^{-6} = 5.7711 \times 10^{-5}$

Taking 7°.47′ as the deflection on the ring tangent corresponding to 1 ampere. $\tan = 0.1366866$.

| | | |
|---|---|---|
| 0.1 | = 0.0136687 | 0°.47′ |
| 0.2 | = 0.0273374 | 1°.34′ |
| 0.4 | = 0.0546748 | 3°.08′ |
| 1.0 | = 0.1366866 | 7°.47′ |
| 1.5 | = 0.2050299 | 11°.35′ |
| 2.0 | = 0.2733732 | 15°.17′ |
| 2.5 | = 0.3417165 | 18°.52′ |
| 3.0 | = 0.4100598 | 22°.18′ |
| 4.0 | = 0.5467464 | 28°.40′ |
| 5.0 | = 0.6833330 | 34°.21′ |
| 6.0 | = 0.8201196 | 39°.21′ |
| 7.0 | = 0.9568862 | 43.44′ |
| 8.0 | = 1.0934928 | 47°.33′ |
| 9.0 | = 1.2301794 | 50°.54′ |
| 10.0 | = 1.3668660 | 53°.48′ |

$5192 \times$ @ 18°.5′ $= .5182$ @ 18°.

| @ 15°.C | = | | + 3 | Tabulation | @ 15 °C. |
|---|---|---|---|---|---|
| | | $\frac{5123}{5135}$ | | 5123 | |
| 16°.5 | = | $\frac{5163}{5175}$ | | 5135 | 16°.5 |
| | | | | 5163 | |
| 17°.5 | = | $\frac{5163}{5175}$ | | 5175 | 17°.5 |
| | | | | 5163 | |
| 18°.5 | = | $\frac{5124}{5136}$ | | 5185 | 18°.5 |
| | | | | 5124 | |
| 19°.5 | = | $\frac{5252}{5264}$ | | 5195 | 19°.5 |
| | | | | 5252 | |
| 20°.5 | = | $\frac{5211}{5223}$ | | 5205 | 20°.5 |
| | | | | 5211 | |
| 21°.5 | = | $\frac{5332}{5344}$ | | 5215 | 21°.5 |
| | | | | 5332 | |
| 22°.5 | = | $\frac{5263}{5275}$ | | 5225 | 22°.5 |
| | | | | 5263 | |

| Time | Volts | Horizontal Deg. Cat. Ohms added 1.7 | Indicated C | Current amperes | Amperes turns | Ohms Temp. | Ohms Cold 17.5°F | Q | Lines per Sq. cm. Tot. Flux |
|---|---|---|---|---|---|---|---|---|---|
| 9.46 | | | | 0 | 0 | h | | 0.023 | 255.6 |
| ·51 | | | | 0 | 0 | h | | | |
| 10.16 | 115.5 | | 0.1 | 0.1 | 190 | 10.9 | 9.80 | 0.057 | 633.4 |
| ·22 | 115.1 | | | | | 9. | | | |
| ·25 | 114.5 | | | | | 9.5 | | | |
| ·28 | 114.4 | | | | | 10. | | | |
| ·34 | 114.7 | | 0.2 | 0.2 | 381 | 17 | 15.00 | 0.104 | 1156 |
| ·42 | 114.7 | | | | | 15.75 | | | |
| ·47 | 114.6 | | | | | 16.2 | | | |
| 11.23 | 114.3 | | 0.4 | 0.4 | 762 | 37.9 | 37.33 | 0.215 | 2389 |
| ·30 | 114.4 | | | | | 37.1 | | | |
| ·35 | 114.3 | | | | | 37. | | | |
| ·49 | 113.8 | 112.23 | 1.0 | 1.0 | 1905 | 88. | 85.5 | 0.493 | 5478 |
| ·59 | 113.7 | | | | | 85.6 | | | |
| ·55 | 113.4 | | | | | 177.0 | | | |
| 12.03 | 113.2 | | | | | 85.9 | | | |
| 13.17 | 112.8 | 73.3 | 1.35 | 1.5 | 2857 | 115.1 | 113.2 | 0.6648 | 7387 |
| ·20 | 113.1 | 73.3 | | | | 114.5 | | | |
| ·23 | 111.2 | | | | | 116. | | | |
| ·43 | 114.4 | 52.6 | 15.15 | 2.0 | 3810 | 140. | 136.4 | 0.8114 | 9017 |
| ·46 | 114.5 | 52.6 | | | | 140.4 | | | |
| ·50 | 114.1 | | | | | 141.6 | | | |
| ·57 | 114.0 | | 19.55 | 2.5 | 4762 | 157.7 | 157.1 | 0.9078 | 10.088 |
| 14.04 | 114.2 | | | | | 157.1 | | | |
| ·07 | 113.2 | | | | | 157.1 | | | |
| ·13 | 113.8 | | 22.20 | 3.0 | 5715 | 167.9 | 166.4 | 0.9724 | 10.806 |
| ·16 | 117.2 | | 22.45 | | | 169.1 | | | |
| ·19 | 113.2 | | 22.25 | | | 168.5 | | | |
| ·45 | 113.2 | 23.5 | 28.60 | 4.0 | 7620 | 177.6 | 178.2 | 1.028 | 11.423 |
| ·54 | 113.4 | | 28.20 | | | 178.1 | | | |
| 15.12 | 115.6 | | 28.40 | | | 178.9 | | | |
| ·19 | 115.7 | 19.9 | 33.50 | 5.0 | 9525 | 184.5 | 188.1 | 1.068 | 11.862 |
| ·25 | 115.1 | | 34.15 | | | 185.9 | | | |
| ·28 | 114.2 | | 34.40 | | | 185. | | | |
| ·44 | 113.2 | 15.5 | 39.15 | 6.0 | 11430 | 194.5 | 198.5 | 1.117 | 12.412 |
| ·46 | 113.2 | 15.43 | 39.15 | | | 196. | | | |
| ·48 | 112.2 | | 39.10 | | | 199.9 | | | |
| ·58 | 113.0 | 12.4 | 43.20 | 7.0 | 13335 | 194. | 198.1 | 1.126 | 12.512 |
| 16.02 | 112.9 | 12.4 | 43.45 | | | 194.1 | | | |
| ·09 | 112.8 | | | | | 195.5 | | | |
| ·15 | 112.3 | 10 | 47.35 | 8.0 | 15240 | 199.5 | 198.4 | 1.1646 | 12.712 |
| ·22 | 113.2 | | 46.35 | | | 197.8 | | | |
| ·27 | 113.1 | | 47.15 | | | 197.4 | | | |
| ·39 | 112.6 | 8.09 | 50.45 | 9.0 | 17145 | 201 | 201.5 | 1.160 | 12.890 |
| ·43 | 112.9 | | 53.45 | 10.0 | 19050 | 205 | 204.5 | 1.189 | 13.213 |
| ·48 | 109.9 | | 53.30 | | | 204.5 | | | |
| ·48 | 111.9 | | 53.40 | | | 207.5 | | | |
| ·51 | | | 53.50 | | | 207.75 | | | |

log 4·06813 0·6093916 = T·7844896 44
0·9398143
2·6460921 = 0·070159

log 4·2929 0·6327508 = T. 8072328
0. 9398143
2. 6624185 = 0·072848



## Wednesday 9th May

8.20

| | No. | P.D. | EMF | C. | J.R. |
|---|---|---|---|---|---|
| | 1 | 0·070 | 0·124 | 0·372 | |
| | 2 | 0·350 | 0·426 | 1·050 | 0·07 |
| | 3 | 0·240 | 0·303 | 0·720 | |
| | 4 | 0·240 | 0·302 | 0·720 | |
| | 5 | 0·236 | 0·298 | 0·708 | |
| | 6 | 0·290 | 0·394 | 0·870 | |
| | 7 | 0·105 | 0·350 | 0·315 | |
| 11.45 | 1 | 0·084 | 0·122 | 0·322 | |
| | 2 | 0·368 | 0·440 | 1·104 | 0·07 |
| | 3 | 0·252 | 0·303 | 0·756 | |
| | 4 | 0·250 | 0·296 | 0·750 | |
| | 5 | 0·242 | 0·294 | 0·726 | |
| | 6 | 0·294 | 0·396 | 0·882 | |
| | 7 | 0·108 | 0·343 | 0·324 | |
| 17.0 | 1 | 0·082 | 0·130 | 0·326 | Removed |
| | 2 | 0·350 | 0·466 | 1·140 | |
| | 3 | 0·252 | 0·284 | 0·756 | |
| | 4 | 0·250 | 0·296 | 0·750 | |
| | 5 | 0·246 | 0·294 | 0·738 | |
| | 6 | 0·296 | 0·396 | 0·888 | |
| | 7 | 0·100 | 0·314 | 0·300 | Removed |

Res. between buried rail 24 feet long & 3 feet apart after water had been poured on the surface of the soil 2 feet above them = 200 ω approx + polarizing

λ observations.

10 Complete vibs in 351·1 sec T = 35·11

$\lambda = \frac{1}{20} \log_e \frac{462.75}{113.75} = \frac{1}{20} \log_e 4.06813 = 0.070159 \quad 1 + \frac{1}{2} = 1.03508$

35·11 × 1·03508 = 36·341

10 Complete vibs in 352·55 sec T = 35·255

$\lambda = \frac{1}{20} \log_e \frac{462.75}{109.25} = \frac{1}{20} \log_e 4.2929 = 0.072848 \quad 1 + \frac{1}{2} = 1.036422$

35·255 × 1·036422 = 37·518

Mean = 36·920

| Time | Volts | Ohms added | Current indicated | Current required | Temp 16°C. Amperes heater | Swing Phase | 7° Conv. a | R.E.D. Ohms per sq. cm. |
|---|---|---|---|---|---|---|---|---|
| 9.53<br>·59<br>10.02<br>·15 | 0 | 0 | 0 | 0 | 0 | 4<br>2.75<br>2<br>2.9 | 0.017 | 187.02 |
| ·27<br>·34 | 113.3<br>114.4 | 4 Lamps + 2. | 0.10 | 0.10 | 190 | 8.9<br>8.6 | 0.032 | 678.9 |
| ·49<br>·52<br>·55<br>·59 | 114.2<br>114.2<br>114.2<br>114.7 | 1 Lamp +60. | 0.20 | 0.20 | 381 | 20.2<br>17.5<br>16.75<br>19.4 | 0.109 | 1213.45 |
| 11.05<br>·09<br>·12<br>·16 | 112.2<br>113.2<br>114.0<br>113.5 | | 0.40 | 0.40 | 762 | 33.8<br>31.2<br>34.<br>32.5 | 0.194 | 2154.8 |
| ·26<br>·30<br>·39 | 116.0<br>112.5<br>112.2 | 112.2 | 50.50<br>7°.45<br>7°.40 | 1.0 | 1905 | 76<br>74.6<br>74.75° | 0.444 | 4943.0 |
| ·50<br>·54<br>13.17<br>·22 | 112.0<br>112.5<br>112.5<br>112.1 | 73.3 | 11°.35'<br>"<br>" | 1.5 | 2857 | 104.6<br>107.75<br>101.7<br>105.7 | 0.622 | 6924.7 |
| ·56<br>14.08<br>·10 | 113.2<br>109.5<br>112.6 | 51.2 | 15°.25'<br>15°.05'<br>15°.20' | 2.0 | 3810 | 130.8<br>130.1<br>134.25° | 0.778 | 8661.5 |
| ·28<br>·45 | 113.4<br>112.2 | 4.249 | 18°.55'<br>18°.50' | 2.5 | 4762 | 152<br>151.2 | 0.896 | 9975.2 |
| ·54<br>·59 | 111.8<br>112.2 | 33.37 | 22°.22'<br>22°.22' | 3.0 | 5753 | 164.3<br>164.5° | 0.978 | 10810. |
| 15.07<br>·12<br>·21 | 9<br>111.8<br>112.4 | 24.9 | 21°.40'<br>"<br>" | 4.0 | 7620 | 179.9<br>176.25<br>177.1 | 1.042 | 11601. |
| ·30<br>·36<br>·39 | 112.6<br>111.8<br>112.2 | 19.91 | 34°.50'<br>34°.20'<br>34°.20' | 5.0 | 9582 | 186<br>185.9<br>185.9 | 1.098 | 12224 |
| ·45<br>·50 | 112.0<br>111.4 | 14.6 | 39°.25'<br>39°.20' | 6.0 | 11506 | 191.5<br>192. | 1.193 | 12619 |
| ·57<br>16.01<br>·06 | 112.0<br>111.7<br>112.2 | 12.9 | 43°.40'<br>43°.40'<br>43°.15' | 7.0 | 13260 | 194.4<br>196.5<br>196.4 | 1.155 | 12857 |
| ·19<br>·24<br>·31 | 112.2<br>111.2<br>111.2 | 9.7 | 47°.10'<br>47°.10'<br>47°.05' | 8.0 | 15230 | 199.25<br>199.75<br>200. | 1.190 | 13137 |
| ·38<br>·43<br>·54 | 110.7<br>111.2<br>109.4 | 7.6 | 51°.05'<br>50°.30'<br>50°.25' | 9.0 | 16970 | 205.9<br>204.<br>204. | 1.203 | 13393 |
| 17.00<br>·05<br>·09<br>·14 | 108.9<br>111.2<br>111.5<br>111.5 | 6.16 | 53°.30<br>54°.15<br>54°.30<br>53°.40 | 10.0 | 19260 | 206.9<br>208.7<br>207<br>210.75 | 1.231 | 13705 |

# Thursday 10th May.

Much inconvenience from leakage in pendulum apparatus. Dismounted and altered all connections.

Experimental cells. 8.20.

| No. | Hours for start | P.D. | EMF | C. | S.R. |
|---|---|---|---|---|---|
| 2 | 45 | 0·350 | 0·436 | 1·050 | 0·07 |
| 3 | " | 0·230 | 0·284 | 0·690 | |
| 4 | " | 0·250 | 0·308 | 0·750 | |
| 5 | " | 0·237 | 0·290 | 0·711 | |
| 6 | " | 0·270 | 0·360 | 0·811 | |
| 7·30 2 | 54 | 0·346 | 0·428 | 1·038 | 0·08 |
| 3 | " | 0·240 | 0·290 | 0·720 | |
| 4 | " | 0·262 | 0·310 | 0·786 | |
| 5 | " | 0·248 | 0·290 | 0·744 | |
| 6 | " | 0·272 | 0·364 | 0·816 | |
| 8 | 0 | 0·451 | 0·600 | 1·353 | |

No 8 cell set up ~~Zinc~~ Cu|Cu Amm. Bromide sol.
" 9 Cu|Cu Amm. Nitrate.
" 10 Cu|Cu Zinc Acetate.
" 11 Cu|Cu Zinc Chloride.

" 12 Cu|Cu ~~Strontium oxide~~ $NH_4Cl$
" 13 $Cu|Cu_2$ Strontium oxide
" 14 $Cu|Cu_2$ Strontium Chloride
" 15 Cu|Cu Sodium acetate
" 16 Cu|Cu Sodium Chloride
" 17 Cu|Cu Potassic acetate
" 18 Cu|Cu Potassic chlorate
" 19 Cu|Cu Ammonium carbonate.

## Friday 11th May

| 9.0 No. | Hours for start | P.D. | EMF | C. | S.R. |
|---|---|---|---|---|---|
| 2 | 69 | 0.330 | 0.426 | 0.990 | |
| 3 | " | 0.230 | 0.276 | 0.690 | |
| 4 | " | 0.252 | 0.310 | 0.756 | |
| 5 | " | 0.230 | 0.290 | 0.690 | |
| 6 | " | 0.260 | 0.342 | 0.780 | |
| 8 | 15 | 0.380 | 0.484 | 1.140 | |
| 9 | 0 | 0.228 | 0.424 | 0.684 | |
| 10 | 0 | 0.224 | 0.536 | 0.672 | |
| 11 | 0 | 0.440 | 0.540 | 1.320 | |
| 17.30 | | | | | |
| 2 | 75 | 0.304 | 0.406 | 0.912 | |
| 3 | | 0.214 | 0.284 | 0.642 | |
| 4 | | 0.240 | 0.276 | 0.720 | |
| 5 | | 0.232 | 0.268 | 0.696 | |
| 6 | | 0.244 | 0.326 | 0.732 | |
| 8 | 24 | 0.350 | 0.428 | 1.050 | |
| 9 | 0 | 0.200 | 0.410 | 0.600 | |
| 10 | 0 | 0.196 | 0.504 | 0.588 | |
| 11 | 0 | 0.382 | 0.456 | 1.146 | |

## Saturday 12th May

| 9.30 | | | | | |
|---|---|---|---|---|---|
| 2 | 93 | 0.294 | 0.388 | 0.882 | |
| 3 | " | 0.218 | 0.254 | | |
| 4 | " | 0.232 | 0.280 | | |
| 5 | " | 0.214 | 0.270 | | |
| 6 | " | 0.244 | 0.330 | | |
| 8 | 39 | 0.320 | 0.414 | | |
| 9 | 15 | 0.177 | 0.362 | | |
| 10 | " | 0.188 | 0.480 | | |
| 11 | " | 0.360 | 0.452 | | |
| 13.15 | | | | | |
| 2 | 98 | 0.286 | 0.380 | | |
| 6 | " | 0.247 | 0.328 | | |
| 8 | 44 | 0.306 | 0.400 | | |
| 11 | 20 | 0.358 | 0.458 | | |
| 12 | 0 | 0.442 | 0.609 | | |
| 13 | 0 | 0 | 0 | | |

log 4·59635 = 66241 32 = T. 8211269
8211269 1·9388143
2·8823126 0·07626

log. 4·5722 = 66013 = T. 8196295
0·9388143
2·8808152 = 0·076

log 4·4986 = 6530774 = T 8144944
0·9388143
2·8761501 = 0·0752



Saturday 12th May

λ Observations.

1st 7 complete vibs in 250·15 secs T = 35·736
5 - - - 175·65 - T = 35·730

1st semiint 441·25 } λ = 1/25 log 4·59635 λ = 0·07624
2nd - 96 1+λ = 1·03813.

2nd 9 complete vibs. in 328·6 secs T = 35·622
5 - - 178·3 - T = 35·66
1st semiint = 435·5 λ = 1/5 log 4·5722 λ = 0·076
2nd - = 95·25 T×λ = 36·076 1+λ = 1·0380

Res: of magnet. 4·765 Res. of leads + app. 6·5; 3·16.
In measuring circuit a current was sent through the galvanometer and needle set swinging naturally. λ Reflected.

3rd 10 complete vibs in 356·5 secs T = 35·65
5 - - 178·25 - T = 35·65
1st semiint 410·5 } λ = 1/5 log 4·4986 λ = 0·0752
2nd - 91·25 T(1+λ) = 38·990 1+λ = 1·0374

Res: of circuit between buried rail
75ω = 0·34 ω per mile
12 volt at terminals would give approx 3·6 amp
12×3·6 = 43·2 Watts or about 1/5 H.P. lost.

Set up a new CuO NH4Cl cell no 12 also one with CuO in solution of strontium oxide

1630

| No. | Hours from start | PD | EMF | e. | ΣR. |
|---|---|---|---|---|---|
| 2 | 1 03 | 0·282 | 0·362 | 0·846 | |
| 6 | 103 | 0·240 | 0·318 | 0·720 | |
| 8 | 4 7 | 0·293 | 0·386 | 0·879 | |
| 11 | 2 3 | 0·340 | 0·434 | 1·020 | |
| 12 | 3 1/4 | 0·420 | 0·504 | 1·200 | |
| 13 | 3 1/4 | 0·0 | 0·04 | 0· | |

$$\frac{n \times 36.978 \times 5225 \times 10^{2} \times 1.6 \times 10^{-4}}{46.57} = \text{Lines per sq. cm.}$$

$$\frac{n \times 3.6978 \times 5.225 \times 1.6 \times 10^{2}}{4.657} = 6.6381 \times 10^{2}$$

| | | |
|---|---|---|
| log | 36.978 | = 1.5679434 |
| - | 5225 | = 3.718086 3 |
| - | 1.6 | = 0.2041120 |
| - | 46.57 | = $\frac{5.4901497}{1.6681062}$ |
| | | $\frac{3.8220435}{2}$ = $6.638 \times 10^{2}$ |

| Time | Volts | Ohms | Current indicated | Current required | Amperes found | 7" swing of Phasor | 0.5 cm. a | E.D. T. 20°C | Lines per sq cm |
|---|---|---|---|---|---|---|---|---|---|
| 10.58 | - | - | | | | - 2.5 | | | |
| 11.00 | | | | | | -2.25 | negligible | | |
| .23 | 111.4 | 3 [illegible] | 0.1 | | 190 | 8.25 | | | |
| .25 | 113.3 | | 0.1 | | | 9.5 | | | 597.4 |
| .31 | 116.0 | | 0.1 | | | 9.25 | | | |
| .37 | 113.7 | 12 + 20.2 | 0.201 | | 381 | 22.25 | | | |
| .42 | 114.0 | | 0.2015 | | | 22.9 | | | 1499 |
| .50 | 113.8 | 12 + 6.2 | 0.40 | | 762 | 43.6 | | | |
| .52 | 113.2 | | 0.40 | | | 45 | | | 2932 |
| .56 | 112.9 | | 0.40 | | | 43.9 | | | |
| 12.03 | 114.8 | 111.4 | 1.05 | | 1905 | 107.1 | 103.1 | | |
| 13.02 | 113.4 | | 1.01 | | | 107.9 | 104.9 | | 6945 |
| .09 | 112.4 | | 1.00 | | | 107.75 | 104.9 | | |
| .14 | 113.8 | 75.02 | 1.35 | | 2857 | 141.9 | 138.9 | | |
| .18 | 113.4 | | 1.35 | | | 142.5 | 140.5 | | 9439 |
| .36 | 113.5 | 54.78 | 2.15 | | 3810 | 167.5 | 168 | | |
| .37 | 113.5 | | 2.15 | | | 166.9 | 165.4 | | 11,112 |
| .38 | 113.7 | | 2.10 | | | 169.5 | 168.7 | | |
| .47 | 112.5 | 42.25 | 2.70 | | 4762 | 182.5 | 182.9 | | |
| .53 | 113.4 | | 2.70 | | | 183 | 182.5 | | 12,176 |
| 46.02 | 112.2 | | 2.70 | | | 183 | 183.3 | | |
| .11 | 113.1 | 33.58 | 3.37 | | 5715 | 190.75 | 190.5 | | |
| .15 | 113.0 | | 3.37 | | | 190.5 | 189.5 | | 12,679 |
| .18 | 113.1 | | 3.37 | | | 192 | 191.8 | | |
| .28 | 113.9 | 23.57 | 4.80 | | 7620 | 208.90 | 208.9 | | |
| .31 | 111.3 | | 4.80 | | | 208.5 | 207.5 | | 13,447 |
| .38 | 112.5 | | 4.80 | | | 209.5 | 203.8 | | |
| .45 | 111.8 | 19.53 | 5.72 | | 9525 | 207.75 | 207.9 | | |
| .51 | 112.7 | | 5.72 | | | 209 | 209.9 | | 13812 |
| .55 | 112.2 | | 5.72 | | | 207.5 | 207.4 | | |
| 15.03 | 112.8 | 16.53 | 6.80 | | 11430 | 214 | 214.15 | | |
| .09 | 112.7 | | 6.80 | | | 210 | 209.9 | | 14,069 |
| .13 | 112.2 | | 6.80 | | | 212.9 | 212.3 | | |
| .24 | 112.2 | 12.14 | 9.25 | | 13,335 | 220.1 | 220.0 | | |
| .27 | 112.6 | | 9.25 | | | 222.5 | 221.9 | | 14,643 |
| .31 | 112.2 | | 9.25 | | | 220.9 | 219.9 | | |
| .39 | 112.1 | 9.97 | 11.25 | | 15240 | 221.6 | 221.7 | | |
| .43 | 112.2 | | 11.25 | | | 224.9 | 224.8 | | 14,904 |
| .48 | 112.1 | | 11.25 | | | 225 | 225.1 | | |
| .53 | 112.4 | 7.82 | 14.00 | | 17,145 | 232 | 231.1 | | |
| 16.02 | 112.2 | | 14.00 | | | 225.6 | 226.8 | | 15,108 |
| .05 | 112.7 | | 14.00 | | | 225 | 224.9 | | |
| .14 | 108.2 | 6.26 | 17.25 | | 19,050 | 234.25 | 234.7 | | |
| .16 | 112.4 | | 17.25 | | | 228.7 | 227.7 | | |
| .26 | 112.2 | | 17.25 | | | 222.4 | 221.9 | | 15 208 |
| .35 | 111.8 | | 17.25 | | | 223 | 223.8 | | |
| .37 | 111.7 | | 17.25 | | | 225 | 225.6 | | |

Monday 14th May

Made following calculation of position of cross in Edison test system.

Res: of lead from Bridge on table no 1 to terminal board 0.079..

| | | | | |
|---|---|---|---|---|
| Res: of Wires and lead to engine room | | | | two leads |
| | + | − | 0.7145 | 0.6355 |
| | + | 0 | 1.0324 | 0.9534 |
| | − | 0 | 1.0310 | 0.9520 |
| | | | | 2.541 |
| | | | | 1.2705 |

| | | | | |
|---|---|---|---|---|
| + Lead from Terminal Board to E.R. | + | 0.3185 | | Library and Lecture room cut off at elevator. |
| − . . . . . | − | 0.3171 | | |
| 0 . . . . . | 0 | 0.6350 | | |

Res: of Circuit composed as follows

| | |
|---|---|
| Lead to Terminal board | 0.079 |
| Engine Room # − and 0 | 0.3171 |
| | 0.635 |
| | 1.031 |

Main neg: and Main neutral wire joined together at catch box on hill and to be distant 1780 feet.

| | |
|---|---|
| Res | 1.4795 |
| Res. of Mains | 0.44645 |

1780 feet of 0.00007149 = 0.1273 ω Main
1780 . . 0.0001827 = 0.3252 . Neutral
0.4525 ω −.44645 = 0.0079

The added Res: was 1000/1000 about 0.50 L Neg: = 0.4850 (Lead)
1000/100 9.45 . . = 0.4823
1000/10 99.0 . . = 0.4807
Accepted distance along Neg 0.4815

Lead L ~~E.R.~~ 0.0395
. E.R. 0.3171
0.3566

0.4815 − 0.3566 = 0.1249 ω
= Dist: of contact from E.R.
0.1273 − .1249 = 0.0024 ω # bw neg: side of catch-box.

Lalande cells.

9.45. 13. 5. 88

| | M | Hours | P.D. | E M F | C | I.R. |
|---|---|---|---|---|---|---|
| $NH_4Cl$ | 2 | 118 | 0·325 | 0·420 | 0·975 | |
| $SbO_2$ | 6 | 115 | 0·294 | 0·406 | 0·882 | |
| $NH_4Br$ | 8 | 64 | 0·334 | 0·436 | 0·902 | |
| ZnCl | 11 | 48 | 0·290 | 0·410 | 0·870 | |
| ~~$NH_4Cl$~~ | 12 | 20 | 0·450 | 0·538 | 1·350 | |
| | | 8.30. 14. 5. 88 | | | | |
| $NH_4Cl$ | 2 | 140 | 0·218 | 0·294 | 0·654 | |
| $SbO_2$ | 6 | 137 | 0·320 | 0·390 | 0·960 | |
| $NH_4Br$ | 8 | 86 | 0·236 | 0·308 | 0·708 | |
| ZnCl | 11 | 70 | 0·186 | 0·250 | 0·558 | |
| $NH_4Cl$ | 12 | 42 | 0·320 | 0·390 | 0·960 | |
| | | 13.30 | | | | |
| $NH_4Cl$ | 2 | 145 | 0·210 | 0·290 | 0·630 | |
| $SbO_2$ | 6 | 142 | 0·220 | 0·320 | 0·660 | |
| | 8 | 91 | 0·232 | 0·304 | 0·696 | |
| | 12 | 47 | 0·320 | 0·380 | 0·960 | |
| $SbO_2$ | 14 | 0 | 0·098 | 0·228 | 0·294 | |
| NaCl | 15 | 0 | 0·208 | 0·422 | 0·624 | |
| NaCl | 16 | 0 | 0·306 | 0·560 | 0·918 | |
| KCl | 17 | 0 | 0·312 | 0·572 | 0·936 | |
| | | 17.30 | | | | |
| $NH_4Cl$ | 2 | 149 | 0·208 | 0·285 | 0·624 | |
| $SbO_2$ | 6 | 146 | 0·224 | 0·320 | 0·672 | |
| $NH_4Br$ | 8 | 95 | 0·234 | 0·308 | 0·702 | |
| $NH_4Cl$ | 12 | 52 | 0·309 | 0·372 | 0·927 | |
| ZnCl | 14 | 5 | 0·142 | 0·208 | 0·426 | removed |
| NaCl | 15 | 5 | 0·174 | 0·274 | 0·522 | |
| NaCl | 16 | 5 | 0·227 | 0·296 | 0·681 | |
| KCl | 17 | 5 | 0·226 | 0·316 | 0·678 | |
| $KClO_3$ | 18 | 5 | 0·318 | 0·440 | 0·954 | |
| $KClO_3$ | 19 | 5 | 0·616 | 0·778 | 1·848 | |

log 5.27419 = ·7221558 log = $\bar{1}$·8586300
0·9388143
$\bar{2}$·9198157 = 0·083141

" 5·3766 = 7305077 $\bar{1}$·8636249
0·9388143
$\bar{2}$·9248106 = 0·084103

" 1·0871 = 0.0362695
$\bar{2}$·5676144
$\bar{1}$·6377843
$\bar{2}$·9298301 0·08508.



# Pendulum Induction

λ observations. Controlling magnet shifted

| | | | | |
|---|---|---|---|---|
| 1st series | 10 complete vibs in | 388·6 secs | T = 38·86 | |
| | 1st 5 " " " | 194·3 " | | |
| | 2nd " " " " | 194·3 " | | |
| 2nd " | 10 " " " | 389·35 " | T = 38·935 | |
| | 1st 5 " " " | 194·75 " | | |
| | 2nd 5 " " " | 194·75 | | |
| | | Mean T | = 38·3975 | |

1st: 1st semivib 408·75, 21st " 77·5 } $\lambda = \frac{1}{20}\log_e 5·27419 = 0·08314$. $1+\frac{\lambda}{2} = 1·04157$

2nd: 1st semivib 424·75, 21st " 79 } $\lambda = \frac{1}{20}\log_e 5·37669 = 0·08410$. $1+\frac{\lambda}{2} = 1·04205$

1st semivib 408·75, 2nd " 376 } $\lambda = \log_e 1·0871 = 0·08508$.

Mean $1+\frac{\lambda}{2}$ = 1·04181

$T \times (1+\frac{\lambda}{2}) = 40·0029$

$$\frac{n \times 40.003 \times 5215 \times 1.6}{4.657} = 71.6.74$$

log 40003 = 0.602099 26
5215 — 0 717254 3
1.6 — 0.2041200
— .2231669
4.6657 — 1.6681062
— .8553607 = 71.674

| time | Volts | Ohms. | Ind. E. | Equivalent current Amperes | Thrust | Corrected Thrust to Reg. E. | A.D. Mean. | 0.7 mm. thrust for eq. amp | (49) |
|---|---|---|---|---|---|---|---|---|---|
| 10.33 | 0 | ∞ | 0 | 0 | 0.0 | | | | |
| .30 | | | | | 2.8 | | | | |
| .43 | | | | | 2.75 | | 2.68 | 192.1 | |
| 11.07 | 114.2 | 3 lamps | 0.1 | 190.5 | 11.9 | 11.9 | | | |
| .15 | 114.9 | +236.2. | 0.103 | | 13.75 | 13.75 | | | |
| .17 | 114.2 | | 0.1 | | 12.75 | 12.75 | | | |
| .20 | 114.2 | | 0.1 | | 11.3 | 11.3 | 12.69 | 909.5 | |
| .24 | 114.8 | 1 lamp | 0.2 | 381 | 21.1 | — | | | |
| .28 | 114.0 | +315.2. | 0.2 | | 22.9 | — | | | |
| .31 | 114.4 | | 0.2 | | 20.8 | — | 21.6 | 1548 | |
| .40 | 114.9 | ? | 0.3 | 571.5 | 32 | — | 32 | 2294 | |
| .47 | 114.7 | ? | 0.4 | 762 | 40.9 | — | | | |
| .53 | 114.2 | ? | 0.4 | | 40.8 | — | 40.65 | 2914 | |
| 12.07 | 114.2 | 110.2 | 0.48707 | 1905 | 92.75 | 92.16 | | | |
| 13.16 | 114.4 | | 0.13609 | | 97 | 97.57 | | | |
| .28 | 114.7 | | 0.13468 | | 96.75 | 104.455 | | | |
| .32 | 114.2 | | 0.13609 | | 96.9 | 96.47 | 96.75 | 6934 | |
| .52 | 114.3 | 76.18 | 0.20246 | 1.00276 | 132.8 | 130.81 | | | |
| 14.09 | 114.2 | | 0.20196 | 2887 | 132.4 | 130.284 | | | |
| .03 | 114.2 | | 0.20497 | | 132 | 132.04 | | | |
| .07 | 114.4 | | 0.20483 | | 133.6 | 134.464 | 132.73 | 9513 | |
| .12 | 114.3 | 52.98 | 0.27416 | 3810 | 164.7 | 160.23 | | | |
| .15 | 113.9 | | 0.27413 | | 165.75 | 163.284 | | | |
| .18 | 113.4 | | 0.27414 | | 165. | 164.51 | | | |
| .23 | 113.0 | | 0.27416 | | 162.3 | 161.81 | 163.42 | 11640 | |
| .29 | 113.8 | 34.1 | 0.36279 | 4762 | 179 | 178.69 | | | |
| .34 | 113.5 | | 0.36270 | | 179.75 | 179.24 | | | |
| .41 | 114.1 | | 0.36270 | | 178.3 | 177.79 | 178.57 | 12795 | |
| .47 | 113.5 | 34.09 | 0.41091 | 5753 | 191.25 | 190.99 | | | |
| .53 | 113.8 | | 0.41081 | | 193 | 192.68 | | | |
| .57 | 113.1 | | 0.41091 | | 190 | 189.65 | 190.71 | 13660 | |
| 15.04 | 113.7 | 24.25 | 0.52862 | 7620 | 199.25 | 198.57 | | | |
| .09 | 113.7 | | 0.52671 | | 201.9 | 201.97 | | | |
| .14 | 113.4 | | 0.52673 | | 202 | 202 | 200.32 | 14394 | |
| .24 | 113.2 | 19.32 | 0.67763 | 9582 | 209.5 | 211.9 | | | |
| .38 | 113.1 | | 0.68304 | | 209.75 | 209.98 | | | |
| .41 | 113.3 | | 0.68286 | | 210 | 208.28 | 210.61 | 15095 | |
| .45 | 112.4 | 15.09 | 0.81461 | 11506 | 213.6 | 213.64 | | | |
| .53 | 112.3 | | 0.81703 | | 216.5 | 215.61 | | | |
| .58 | 112.5 | | 0.82140 | | 210.9 | 210.9 | 214.29 | 15360 | |
| 16.02 | 112.4 | 12.53 | 0.97723 | 13240 | 219.75 | 218.53 | | | |
| .06 | 112.5 | | 0.97734 | | 213.1 | 212.1 | | | |
| .10 | 112.5 | | 0.97771 | | 212.4 | 216.03 | 216.22 | 15496 | |
| .16 | 112.8 | 9.91 | 1.09245 | 15030 | 218.5 | 218.5 | | | |
| .21 | 112.4 | | 1.09245 | | 218.7 | 218.7 | | | |
| .25 | 112.8 | | 1.09245 | | 220. | 220. | | | |
| .31 | 112.3 | | 1.09245 | | 220.2 | 220.21 | 219.52 | 15732 | |
| .38 | 112.9 | 7.99 | 1.23183 | 16970 | 222.9 | 222.72 | | | |
| .45 | 111.6 | | 1.23758 | | 226.9 | 227.38 | | | |
| .55 | 111.5 | | 1.23914 | | 228.6 | 226.75 | 225.62 | 16170 | |
| 17.01 | 112.1 | 7.31 | 1.36800 | 19260 | 235.25 | 235.06 | | | |
| .07 | 112.2 | | 1.39148 | | 230.7 | 231.92 | | | |
| .11 | 112.7 | | 1.39168 | | 233. | 234.22 | 234.73 | 16822 | |

log 4·88618 = 0·6889700 = 7·83820
0·93881
2·89939 0·07932 1·03961

log 5·314444 = 0·7254475 = 7·86063
0·92881
·92182 = 0·08352 1·04176
08137
04069



# Pendulum Induction

Tuesday) 15th May

| | | | | | |
|---|---|---|---|---|---|
| λ. A | 10 complete vibs | in | 382·75 | = | T = 38·275 |
| | 1st 5 | | 191·25 | = | 38·250 |
| | 2nd | | 191·50 | = | 38·310 |
| B | 10 complete vibs | in | 389·95 | = | T = 38·995 |
| | 1st 5 | | 194·25 | | = 38·90 |
| | 2nd 5 | | 194·5 | | = 38·90 |

Mean T = 38·590

1st series.

1st terminal 457·75 } $\lambda = \frac{1}{2}\log_e 4·88618 = 0·07932$
2nd 92·25 } $1+\frac{1}{2} = 1·03961$

3rd series

1st terminal 469 } $\lambda = \frac{1}{2}\log_e 5·314444 = 0·08352$
2nd 88·25 } $1+\frac{1}{2} = 1·04176$

Mean $1+\frac{1}{2} = 1·04069$

Mean $T \times 1+\frac{1}{2} = 40·160$

Lalande cells. 8·00

| No. | Nature of Solution | Hours from start | P.D. | E.M.F. | C. | I.R. |
|---|---|---|---|---|---|---|
| 2 | $NH_4Cl$ | 164 | 0·190 | 0·274 | 0·570 | — |
| 6 | $SnO_2$ | 160 | 0·206 | 0·312 | 0·618 | |
| 8 | $NH_4Br$ | 110 | 0·215 | 0·276 | 0·645 | |
| 12 | $NH_4Cl$ | 67 | 0·280 | 0·352 | 0·860 | |
| 16 | NaCl | 20 | 0·200 | 0·292 | 0·600 | |
| 17 | K acet | 20 | 0·190 | 0·296 | 0·570 | |
| 18 | $KClO_3$ | 20 | 0·220 | 0·262 | 0·660 | |
| 1130 Aug 6 | $SnO_2$ | 170 | 0·192 | 0·278 | 0·576 | |
| 8 | $NH_4Br$ | 120 | 0·204 | 0·274 | 0·612 | |
| 12 | $NH_4Cl$ | 77 | 0·249 | 0·324 | 0·747 | |
| 16 | NaCl | 30 | 0·148 | 0·294 | 0·444 | |
| 18 | $KClO_3$ | 30 | 0·183 | 0·266 | 0·549 | |
| 19 | $NH_4ClO_3$ | 0 | 0·034 | 0·277 | 0·102 | |
| 20 | $Na_2SO_4$ | 0 | 0·183 | 0·447 | 0·549 | |
| 21 | Brom | 0 | 0·040 | 0·120 | — | |

| Time | Volts | Ohms. | Sol. C. | Resy. corr. ambient temp. | Temp. 17°C Mean Ohms | Corrected to sol. c. | Corrected Mean Ohms | Log. Lumo for sol. | |
|---|---|---|---|---|---|---|---|---|---|
| 11·23 | 114·9 | 32·+174 | 0·1 | 190·5 | ? 6·8 | 6·8 | 7·57 | 5144·7 | |
| ·24 | 114·9 | | | | 8·6 | 8·6 | | | |
| ·35 | 115·0 | | | | ? 7 | 7· | | | |
| ·39 | 114·3 | | | | 7·2 | 7·2 | | | |
| ·45 | 114·3 | 22+684 | 0·2 | 381 | 14 | 14 | 17·84 | 12844 | |
| ·48 | 114·7 | | | | ? 17·4 | 17·4 | | | |
| ·52 | 114·8 | | | | ? 18·4 | 19·4 | | | |
| ·58 | 114·8 | 12+46·1 | 0·4 | 762·0 | 32·5 | 32·5 | 32·6 | 23·46 | |
| 12·13 | 115·2 | | | | 32·7 | 32·7 | | | |
| ·16 | 114·7 | | | | 32·6 | 32·6 | | | |
| ·21 | 114·7 | 110·23 | 0·13758 | 1905 | 82 | 81·47 | 80·444 | 5788 | |
| ·25 | 114·4 | | " | | 79·9 | 79·37 | | | |
| ·29 | 114·6 | | " | | 81 | 80·47 | | | |
| ·40 | 115·0 | 73·57 | 0·20497 | 2849 | 110·1 | 110·13 | 107·99 | 7914 | |
| ·46 | 115·7 | | 0·20608 | | 110·6 | 109·82 | | | |
| ·56 | 115·0 | | 0·20607 | | 110· | 110·03 | | | |
| ·54 | 114·5 | 53·14 | 0·27619 | 2.889 | 135·6 | 135·2 | 134·49 | 13743 | |
| ·57 | 115·6 | | 0·27619 | | ? 132·9 | 133·45 | | | |
| 13·03 | 115·7 | | 0·28360 | | 135 | 133·02 | | | |
| ·15 | 115·0 | 42·19 | 0·34109 | 4562 | 157·25 | 157·55 | 158·89 | 11,430 | |
| ·29 | 114·4 | | 0·34108 | | 159·75 | 160·05 | | | |
| ·33 | 114·3 | | 0·33945 | | 158· | 159·06 | | | |
| ·41 | 113·2 | 33·57 | 0·40911 | 5755 | 164·6 | 165·09 | 168·69 | 12,138 | |
| ·45 | 113·2 | | 0·40681 | | ? 165·9 | 167·99 | | | |
| ·52 | 114·7 | | 0·40671 | | 164·44 | 164·09 | | | |
| 14·01 | 114·4 | 25·10 | 0·54673 | 7620 | 182·7 | 182·47 | 181·802 | 13,080 | |
| ·05 | 114·5 | | " | | 181· | +86·44 | | | |
| ·10 | 114·9 | | " | | 181·75 | 181·716 | | | |
| ·17 | 114·7 | 19·94 | 0·68524 | 9550 | 198·1 | 197·6 | 181·28 | 13,260 | |
| ·21 | 114·7 | | 0·68301 | | 195·2 | 195·27 | | | |
| ·25 | 115·6 | | 0·68576 | | ? 181·5 | 181·01 | | | |
| ·29 | 114·5 | | 0·68301 | | 181·5 | 181·59 | | | |
| ·37 | 114·5 | 15·94 | 0·84966 | 14,580 | ? 190· | 190·12 | 189·97 | 13,670 | |
| ·46 | 115·1 | | 0·82400 | | 189·3 | 189·26 | | | |
| ·50 | 114·5 | | 0·81966 | | 193 | 193·10 | | | |
| ·54 | 115·5 | | 0·82190 | | ? 196·25 | 195·79 | | | |
| 15·00 | 114·7 | 12·65 | 0·95251 | 19,240 | 199 | 199·115 | 198·6 | 14,240 | |
| ·09 | 114·7 | | 0·95251 | | 196·9 | 197·34 | | | |
| ·15 | 114·8 | | 0·95799 | | 199·1 | 198·85 | | | |
| ·27 | 115·2 | 10·20 | 1·09179 | 23,080 | 201·5 | 200·71 | 202·4 | 14,660 | |
| ·29 | 115·2 | | 1·09450 | | 204·4 | 203·31 | | | |
| ·34 | 113·5 | | 1·09151 | | 201·75 | 202·17 | | | |
| ·42 | 114·7 | 8·09 | 1·23123 | 16,970 | 204·2 | 204·03 | 203·95 | 14,680 | |
| ·49 | 114·2 | | 1·23123 | | 204·0 | 203·84 | | | |
| 16·57 | 113·7 | 6·82 | 1·3680 | 19,260 | 211·5 | 211·35 | 209·01 | 15,040 | |
| 17·02 | 114·8 | | 1·3680 | | 205·75 | 205·80 | | | |
| ·09 | 114·1 | | 1·3597 | | 209· | 210·11 | | | |

Tuesday 16th May

Set meter to work with plates of pure zinc cast from zinc obtained electrolytically by Mr Wiley. These had a brass wire cast into them. The top surface and the brass wire were three time coated with shellac varnish. The zinc plates were amalgamated twice. The analysis of the metal from which the zinc was cast (in my) showed no iron and less than 0.2 % of other metallic impurities. The solution was C.P. $ZnSO_4$ sp. g. 1.0574. The plates weighed as follow.

| No. | Individual weight | Joint weight | No. | Individual weight | Joint weight |
|---|---|---|---|---|---|
| 1 | 21.747 | 43.860 | 11 | 21.1768 | 43.2668 |
| 2 | 22.1135 | | 12 | 22.0906 | |
| 3 | 22.101 | 43.698 | 13 | 21.4184 | 44.3531 |
| 4 | 21.598 | | 14 | 22.9349 | |
| 5 | 21.203 | 42.877 | 15 | 22.5124 | 44.9578 |
| 6 | 21.5765 | | 16 | 22.4460 | |
| 7 | 22.1244 | 44.3466 | 17 | 22.2092 | 44.1010 |
| 8 | 22.2224 | | 18 | 21.8929 | |
| 9 | 21.507 | 43.8984 | 19 | 21.3635 | 43.2652 |
| 10 | 22.391 | | 20 | 21.9017 | |

All the above ~~figures~~ quantities are observed and the agreement is very close throughout

The rubber screw head presses on nos 1 3 5 7 &c and the washer presses on nos 2 4 6 8 &c.

All the bottles had liquid in them to the same height approx.

These meters were set to work at 10.0 . 17. 5. 88 through 40 in.
at night they are set on the night cut thro 17.

log 4·8112 = 0·68225 = 7·933 94
·93881
·89513 78547

4·933 = 0·69311 = 7·84080
·93881
90199 7980



## Wednesday 16th May

Pendulum observations

| | | | T. | | |
|---|---|---|---|---|---|
| 1st series | 10 complete vibs in | 377·6 secs | T = | 37·76 |
| 1st | 5 | " " " | 188·8 | " | = 37·76 |
| 2nd | 5 | " " " | 188·8 | " | = 37·76 |
| 2nd series | 10 | " " " | 381·6 | T = | 38·16 |
| 1st | 5 | " " " | 190·65 | | = 38·13 |
| | | | 190·95 | | = 38·19 |

Mean T = 37·96.

1st series $\left\{\begin{array}{l}\text{1st semicircle} = 452·25 \\ \text{2nd " " } = 94\end{array}\right\}$ $\lambda = \frac{1}{20}\log_e 4·8112 = 0·07855$
$1 + \frac{\lambda}{2} = 1·03927$

2nd $\left\{\begin{array}{l}\text{1st semicircle} = 446·0 \\ \text{2nd " " } = 93·25\end{array}\right\}$ $\lambda = \frac{1}{20}\log_e 4·7830 = 0·07980$
$1 + \frac{\lambda}{2} = 1·03990$

Mean $1 + \frac{\lambda}{2}$ = 1·03958 × mean T(37·96) = 39·462

| Time | Volts | Ohms | Ind. C. | Amp. hours | 1·5 ohm Tr. Error | Corrected Error | Mean | R (Sp. Error per Log-ohm) |
|---|---|---|---|---|---|---|---|---|
| 8·58 | 0 | – | 0 | | 2·2 | 2·2 | 2·27 | 161·1 |
| 10·03 | 0 | – | 0 | | 2·2 | 2·2 | | |
| ·11 | 0 | – | 0 | | 2·2 | 2·2 | | |
| ·39 | 114·0 | 14 L. | 0·099 | 1905 | 9· | 9· | 9·29 | 657 |
| ·44 | 111·7 | | 0·09975 | | 11·4 | 11·4 | | |
| ·51 | 113·3 | | 0·09885 | | 9· | 9· | | |
| ·55 | 112·7 | | 0·09885 | | 7·75 | 7·75 | | |
| 11·06 | 114·1 | 32 + 35 [illegible] | 0·21 | 381 | 15·4 | 14·67 | 14·9 | 1057 |
| ·09 | 110·8 | | ·19 | | 13· | 13·69 | | |
| ·15 | 114·3 | | ·197 | | 16·1 | 16·35 | | |
| ·24 | 112·2 | 12 + 49·5 | 0·395 | 762 | 27·3 | 27·65 | 28·31 | 2009 |
| ·42 | 114·8 | | 0·415 | | 29·7 | 28·63 | | |
| ·48 | 113·5 | | 0·400 | | 28·65 | 28·65 | | |
| 12·00 | 118·5 | 110·23 [illegible] | 0·13609 | 1905 | 68·8 | 69·11 | 68·56 | 4865 |
| 13·10 | 114·0 | | 0·13609 | | 68·8 | 68·91 | | |
| ·19 | 114·14 | | 0·13758 | | 68·60 | 67·66 | | |
| ·27 | 113·6 | 72·93 [illegible] | 11·35' | 2857 | 96·3 | 96·33 | 96·04 | 6815 |
| ·31 | 113·2 | | 11·30' | | 95·1 | 95·86 | | |
| ·38 | 114·0 | | 11·38' | | 95·9 | 95·93 | | |
| ·45 | 112·7 | 54·11 [illegible] | 15°15' | 3810 | 120·25 | 120·58 | 121·87 | 8648 |
| ·50 | 111·9 | | 14°55' | | 120. | 123·15 | | |
| 14·01 | 112·4 | 41·9 [illegible] | 18°50 | 4762 | ?140·9 | 141·18 | 140·0 | 9935 |
| ·09 | 113·6 | | 18°55 | | 140·25 | 139·85 | | |
| ·18 | 113·3 | | 18°55 | | ? 139·5 | 139·11 | | |
| ·23 | 116·0 | 33·96 [illegible] | 22°20 | 5715 | 157·1 | 156·81 | 157·58 | 11180 |
| ·28 | 113·6 | | 22°30 | | 156·75 | 159·16 | | |
| ·34 | 113·5 | | 22°25 | | 157·7 | 156·76 | | |
| ·48 | 112·2 | 24·74 [illegible] | 28°20' | 7620 | 172·25 | 174·65 | 171·68 | 12180 |
| ·54 | 112·2 | | 28°40' | | 170·1 | 170·11 | | |
| ·58 | 113·2 | | 28°40' | | 172·8 | 170·29 | | |
| 15·07 | 113·0 | 20·167 [illegible] | 34°20' | 9525 | ? 179·25 | 179·36 | 179·89 | 12770 |
| ·11 | 112·2 | | 34°15' | | 179·1 | 179·10 | | |
| ·16 | 112·5 | | 34°10' | | 179·7 | 180·04 | | |
| ·26 | 112·6 | 15·67 | 39°20' | 11420 | 188·1 | 188·24 | 187·88 | 13330 |
| ·32 | 112·6 | | 39°20' | | ? 186. | 186·15 | | |
| ·40 | 112·6 | | 39°20' | | 188·25 | 188·40 | | |
| ·47 | 110·2 | 12·55 | 43°45' | 13335 | 190·1 | 189·98 | 191·4 | 13582 |
| ·58 | 112·6 | | 44°0' | | ? 191·9 | 190·12 | | |
| 16·03 | 112·9 | | 43°40' | | 193 | 193·67 | | |
| ·10 | 112·5 | 10·20 | 47°35' | 15240 | 197·3 | 197·11 | 196·4 | 13940 |
| ·13 | 112·5 | | 47°35' | | 196·44 | 196·23 | | |
| ·17 | 112·5 | | 47°35' | | 196 | 195·81 | | |
| ·24 | 112·4 | 8·38 [illegible] | 51°05' | 17,145 | 202 | 200·62 | 200·23 | 14210 |
| ·31 | 112·2 | | 50°55' | | 199·8 | 199·63 | | |
| ·40 | 111·8 | | 50°50' | | 200 | 200·43 | | |
| ·49 | 111·5 | 6·73 | 53°35' | 19,050 | 206·1 | 205·82 | 205·10 | 14580 |
| ·53 | 111·6 | | 53°40' | | 203·25 | 204·32 | | |
| ·57 | 111·4 | | 53°45' | | 204·7 | 205·14 | | |

## Thursday 17th May.

10·30 Motor for a phonograph started by 10 cell Nitric Bichr battery.

Levelled the new Edison property.

## Friday 18th May

Pendulum observations

T. 10 complete ibs in 409·47 sec $T = 40·947$

10 - - - 409·55 - $T = 40·955$

Mean $T = 40·951$

$\lambda$ 1st swing $= 414·75$, 21st $= 66·25$ $\Big\}$ $\lambda = \frac{1}{20} \log_e \frac{414·75}{66·25} = 0·09022$

$1 + \frac{\lambda}{2} = 1·04511$

1st swing $= 402·75$, 21st $= 66·5$ $\Big\}$ $\lambda = 0·09086$ $1 + \frac{\lambda}{2} = 1·04500$

Mean $1 + \frac{\lambda}{2} = 1·04506 \times 40·951 = 42·796$

Day Constant $= n \times \frac{5·171 \times 10^{12} \times 42·796 \times 1·6 \times 10^{-16} \times 10^{-7}}{4·657 \times 10^{1}}$

$= n \times \frac{5·171 \times 4·2796 \times 1·6}{4·657} \times 10^{1}$

$D = 7·6031\, n \times 10^{1} = 76·031\, n.$

Took some preliminary photometric measurements as follows—

Compared our standard Carcel lamp with two Edison lamps that had been standardized at Newark and also with two standard candles.

1st Lamp 60" from Carcel flame.
marked 99½

| Time | Current. | | P.D. at lamp. | | Res: in cent 130 volt ckt | Illumination | | |
|---|---|---|---|---|---|---|---|---|
| | P.D. across | Check | P.D. across 1000 | P.D. across lamp | Ohms | Carcels | | |
| 16·30 | 0·377 | | 0·813 | 81·3 | 140ω | 0·40 | | |
| ·35 | 0·444 | | 0·921 | 92·1 | 100ω | 0·87 | | |
| ·40 | 0·465 | | 0·954 | 95·4 | 90ω | 1·05 | | |
| ·43 | 0·470 | | 0·988 | 98·8 | 80ω | 1·36 | | |
| ·46 | 0·447 | | 1·008 | 100·8 | 76ω | 1·48 | | |
| ·49 | 0·492 | | 0·990 | 99·0 | 78ω | 1·38 | | |
| ·52 | 0·493 | | 0·992 | 99·2 | 77ω | 1·35 | | |

2nd Lamp. marked 100½

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ·57 | 0·512 | | 0·986 | 98·6 | 77 | 1·27 | | |
| 17·00 | 0·517 | | 0·992 | 99·2 | 75 | 1·29 | | |
| ·2 | 0·524 | | 1·003 | 100·3 | 73 | 1·39 | | |
| | Changed | simple | screw | for me | of paraffine | from wax | chop | |
| ·10 | 0·520 | | 1·00 | 100· | 73 | 1·48 | | |
| ·12 | 0·526 | | 1·006 | 100·6 | 72 | 1·50 | | |
| 1st | Lamp | again | with | paraffine | screw | | | |
| ·15 | 0·502 | 0·098 | 1·008 | 100·8 | 75 | 1·58 | | |
| ·18 | 0·498 | 0·097 | 1·00 | 100· | 77 | 1·53 | | |
| ·20 | 0·494 | 0·096 | 0·997 | 99·7 | 79 | 1·43 | | |
| ·25 | 0·488 | | 0·995 | 99·5 | 80 | 1·40 | | |
| ·30 | 0·492 | | 0·992 | 99·2 | 82 | 1·38 | | |

2 standard Candles which burnt regularly were averaging at Carcel 5·8 during 701 seconds while they lost 40 grains. They should have lost 40 grains in 600 sec. ∴ that 1 Carcel = $\frac{5.8 \times 600}{701}$ = 5·82.
= 11·642 c.f. × 1·38 = 16·06 c.f.

$$a = \frac{d \times 0.7175 \times 10^{-7}}{154.75}$$

D.P.D. [illegible] 2 cms

$$b = a \times R$$

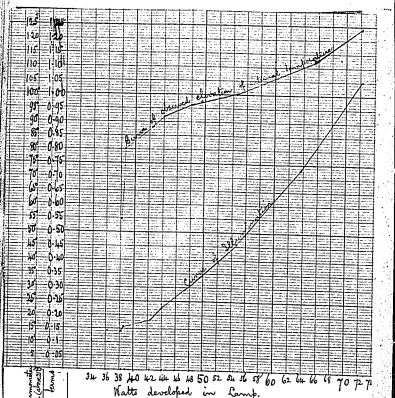
$$= \frac{d \times 0.7175 \times 10^{-7} \times 5170}{154.75} = d \, \frac{5.17 \times 7.175 \times 10^{-7}}{1.5475}$$

$$= \frac{d \times 2397}{46.57} = 51.47 d.$$

log 0.7175 = 7.85582
5170 = 3.71349
3.56931
3.857774
0.571557 $0.571557 \times 10^{2}$

log 154.75 = 2.18963
46.57 = 1.66811
3.857774

| Time | Volts | Ohms | Ind. C. | Ignition index | Throw | Corrected throw | Adjusted Mean Ignition | 157 Amp Eq |
|---|---|---|---|---|---|---|---|---|
| 10.20 | | | | | 2.3 | | | |
| .35 | | | | | 2.0 | | 2.1 | 108.2 |
| .47 | | | | | 2.1 | | | |
| 11.06 | 116.2 | 42+ | 0.1 | 190.5 | 7.4 | 7.4 | | |
| .21 | 115.7 | 10.3 | 0.1 | | 6.8 | 6.8 | 7.38 | 379 |
| .27 | 115.6 | | 0.1 | | 6.75 | 6.75 | | |
| .36 | 115.2 | 2.2+473 | 0.2 | 381 | 12.5 | 12.5 | | |
| .40 | 115.0 | | 0.2 | | 13.1 | 12.1 | 12.97 | 668 |
| .45 | 115.0 | | 0.2 | | 13.3 | 13.3 | | |
| .51 | 115.0 | 1.2+656 | 0.4 | 762 | 23.7 | 23.7 | | |
| .56 | 114.9 | | 0.349 | | 23.8 | 23.85 | 23.83 | 1227 |
| 12.01 | 114.4 | | 0.325 | | 23.9 | 23.95 | | |
| 13.17 | 114.2 | 110.23 | 0.18689 | 1905 | 57.90 [illegible] | 58.03 | | |
| .23 | 114.3 | | 0.13656 | | 57.8 | 57.93 | 57.93 | 2982 |
| .27 | 114.3 | | 0.13656 | | 57.8 | 57.93 | | |
| .35 | 114.7 | 73.46 | 0.202497 | 2887 | 84 | 84 | | |
| .39 | 114.7 | | 0.202497 | | 82.4 | 82.4 | 83.4 | 4293 |
| .44 | 115.0 | | 0.202497 | | 82.8 | 83.5 | | |
| .53 | 114.3 | 53.27 | 0.273224 | 3810 | 106.9 | 106.94 | | |
| 14.00 | 114.4 | | 0.273224 | | 107 | 107.04 | 106.9 | 5502 |
| .09 | 114.5 | | 0.274019 | | 107 | 106.68 | | |
| .19 | 112.0 | 42.35 | 0.337783 | 4762 | 127.9 | 128.37 | | |
| .24 | 112.4 | | 0.344270 | | 124.75 | 125.39 | 126.2 | 6496 |
| .32 | 112.4 | | 0.344270 | | 125.3 | 124.94 | | |
| .45 | 114.1 | 34.81 | 0.409911 | 5715 | 140.8 | 140.73 | | |
| .50 | 114.3 | | 0.410891 | | 139.3 | 139.05 | 140.3 | 7273 |
| .55 | 114.4 | | 0.411871 | | 140.1 | 140.95 | | |
| 15.02 | 113.7 | 25.69 | 0.524.60 | 7620 | 159.4 | 159.05 | | |
| .14 | 114.0 | | 0.524.62 | | 159.75 | 158.21 | 160.35 | 8253 |
| .19 | 112.7 | | 0.531171 | | 159.4 | 162.88 | | |
| .30 | 113.8 | 20.365 | 0.68307 | 9525 | 169.1 | 161.1 | | |
| .37 | 113.6 | | 0.683.71 | | 168.4 | 161.14 | 168.3 | 8662 |
| .41 | 112.4 | | 0.685146 | | 165.7 | 163.3 | | |
| 16.08 | 112.2 | 18.057 | 0.819246 | 11420 | 216.8 | 164.93 | | |
| .15 | 111.0 | | 0.824.90 | | 171.7 | 171.33 | 170.68 | 8770 |
| .19 | 111.2 | | 0.824.90 | | 171.1 | 170.73 | | |
| .24 | 109.2 | 13.85 | 0.96898 | 13335 | 176.0 | 176.44 | | |
| .28 | 113.2 | | 0.95753 | | 176.5 | 175.74 | 177.37 | 9131 |
| .32 | 113.9 | | 0.95751 | | 179.5 | 178.42 | | |
| .42 | 113.2 | 10.49 | 1.09450 | 15240 | 184.1 | 185.02 | | |
| .46 | 113.3 | | 1.09131 | | 184.8 | 185.17 | 186.25 | 9589 |
| .49 | 112.9 | | 1.09131 | | 187.3 | 187.67 | | |
| .54 | 118.9 | 8.71 | 1.22638 | 17115 | 191 | 192.28 | | |
| .57 | 113.0 | | 1.22758 | | 189.8 | 190.20 | 191.98 | 9972 |
| 17.05 | 112.5 | 7.11 | 1.36800 | 19.050 | 195.1 | 194.94 | | |
| .09 | 112.4 | | 1.36800 | | 193.4 | 193.34 | 193.70 | 9970 |
| .14 | 112.3 | | 1.36813 | | 192.1 | 192.94 | | |






## Saturday 19th May.

Made following measurements of illumination and temperature of an Edison lamp.

The 99½ volt lamp tested on the previous day was employed as the standard of light and its voltage was maintained constant during the experiment with the aid of a rev. box and an A.M. voltmeter.

The lamp under test is an ordinary 16 cp lamp with a Fahr. thermometer enclosed in the vacuum. The photometer chamber in which it rested was 53 ins wide 63 ins (back to front width) and 73 high. The thermometer in the lamp gives 212° high. The thermometer in the lamp gives 212° high. The thermometer was standard by its side at 15°C.

| Time | P.D. across the lamp | C. | Observed C. | CP | P.D. across lamp per cp | Res. | Int. Temp | Ex Cl. Temp in Room | Cs. by Observed Current and P.D. | Energy in lamp in watts |
|---|---|---|---|---|---|---|---|---|---|---|
| 11.09 | 0.500 | 0.5015 | 0.101 | 0.11445 | 0.710 | 170. | 70.5° | 22.5° | | 38.11 |
| " 14 | 0.504 | 0.5055 | 0.107 | 0.1587 | 0.762 | | 101.1 | 23.5 | 0.592 | 38.62 |
| " 23 | 0.530 | 0.5316 | 0.106 | 0.1818 | 0.795 | | 109° | 24.9 | 0.626 | 42.26 |
| " 34 | 0.544 | 0.5456 | 0.107 | 0.2299 | 0.807 | | 118° | 25. | 0.531 | 48.90 |
| " 37 | 0.570 | 0.5717 | 0.114 | 0.3077 | 0.840 | | 117. | 25.5 | 0.566 | 48.02 |
| " 39 | 0.612 | 0.6138 | 0.123 | 0.4546 | 0.890 | | 121° | 26. | 0.611 | 54.63 |
| " 42 | 0.670 | 0.6720 | 0.134 | 0.730 | 0.950 | | 133° | 24.5 | 0.665 | 63.84 |
| " 46 | 0.719 | 0.7211 | 0.144 | 1.05 | 1.000 | | 145° | 24.5° | 0.715 | 72.11 |

Several throws and series of λ were obtained with the ballistic Galv. as follows:—

1 Batt. all 1.1455 volts through 0.5 ϕ = 154.25 v 0.5
155.75 T. 0.85
153.90 0.85
2 × 155.70 −1.35
309.60 2.70

$= .7175 \times 10^{-7}$ a.

T =

Mean. 154.75 ± 0.33

$\frac{0.6453 \times 2.7}{4 \times 1.722} = 0.324$

## Monday 21st May.

Made following determination of position of cross in Edison pressure wire system.

Res: of lines from Bridge to E.R. + and − only, the neutral being faulty — 0.7114

Res: of these lines + + and − mains — 0.9606 − 0.7114 = 0.2542

| | | | | | |
|---|---|---|---|---|---|
| − | + | + | − | 0 | 1.1593 = 0.4479 |
| − | + | − | − | 0 | 1.1595 = 0.4481 |

From which Res. of + Main = 0.1270

− − − = 0.1272

− − 0 − = 0.3209

Added Res. in Varley Balance

to neg. lead main 1000/1000 0.2w = 0.4797ω from bridge

1000/100 8.337 = 0.4780 − −

1000/10 67.6 = 0.4787 − −

The res: of the neg: lead to E.R. is supposed to be 0.7114 ÷ 2 = 0.3557 including battle wires.

0.4787 − 0.3557 = 0.1230 ω from end of tube

0.1272 − 0.1230 = 0.0042 ω from catch box in neg. main

$0.0042 \div 0.00007.15 = 42 \times 10^{-4} \div 7.15 \times 10^{-5}$

= 60 feet from catchbox.

Res: of contact was about 120ω

The result of the 14th May page 46 was 0.0249 for end of neg. main.

On examining connection in Engine Room found mains connected by two groups of 5 lamp heads in the Engine room, so that assuming the res: of a lamp at 400ω this would be 80ω between + 0 also 80ω between − and zero. Removed these and tested again.

| | | | |
|---|---|---|---|
| Made + 0 Main | 0.1270 | Res: of contact now | 130,000ω |
| − − | 0.1282 | Ins: of pressure wire | 3,600ω |
| 0 − | 0.3242 | No reliable balance obtainable. | |

Insulation of the whole Edison system jump up about 3000ω

T' during 2·5 cm. Interpolar Dist.

Throws from 1 Bl. Rho: 0·5 t = ·7176 microvoltsmtr.

| | | | |
|---|---|---|---|
| 1st | L | 131 | −0·25 |
| 2nd | R. | 132·5 | + 1·75 |
| 3rd | | 134 | + 3·25 |
| 4th | L | 125·5 | −5·25 |
| | | 3·0 | 10·5 = 2v |

Mean 130·75 ± 1·3

$\frac{0.848 \times 10.5}{4 \times 1.73} = 1.3$

$$a = \frac{d \times \cdot 7176 \times 10^{-7}}{130.75}$$

$$\mathfrak{L} = \frac{d \times 0.7176 \times 10^{-7} \times 5.190 \times 10^{3}}{130.75 \times 46.657} = \frac{7.176 \times 5.190 \times 10^{1}}{1.3075 \times 46.657}$$

$= 61.16.$

log ·7176 = ·85588
5·190 = ·71517
57105

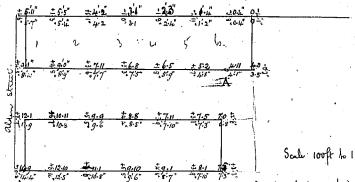
log 130·75 = ·116444
46·57 = ·66811
78455

78455
78455 = 61.16

| Time | Volts | Ohms | Ind. B. | Phase | Corrected | Adjusted Mean | Induction Constant per L | 60 |
|---|---|---|---|---|---|---|---|---|
| 18·05 | 115·4 | 324·270 | 0·1 | 5 | 5 | | | |
| ·20 | 115·4 | - | 0·1 | 4·8 | 4·8 | | | |
| ·35 | 114·9 | - | 0·1 | ?5·75 | 5·75 | 5·2 | 318 | |
| ·49 | 115·5 | | 0·10095 | 5·5 | 5·5 | | | |
| ·28 | 115·7 | 12 + 324 | 0·2 | 10·3 | 10·3 | | | |
| ·38 | 115·1 | - | 0·10095 | 10·0 | 10·0 | 10·16 | 621 | |
| ·39 | 115·0 | - | 0·2 | ? 10·2 | 10·2 | | | |
| ·47 | 114·5 | 12·67 | 0·4 | 18·0 | 18·0 | | | |
| ·51 | 116·0 | | 0·40095 | 18·0 | 18·0 | | | |
| ·55 | 118·3 | | 0·4 | 16·8 | 16·8 | 18·20 | 1113 | |
| ·59 | 114·7 | - | 0·4 | 18·0 | 18·0 | | | |
| 13·14 | 113·9 | 110·23 | 0·13669 | 46·6 | 46·6 | | | |
| ·23 | 113·7 | | 0·13669 | 46·9 | 46·9 | 46·8 | 2863 | |
| ·29 | 114·2 | | 0·13768 | 47·1 | 46·8 | | | |
| ·43 | 114·7 | 73·32 | 0·20497 | 65·75 | 65·75 | | | |
| ·48 | 114·2 | | 0·20497 | 64·6 | 64·15 | 64·66 | 3955 | |
| ·55 | 114·5 | | 0·20497 | 64·1 | 64·1 | | | |
| 14·05 | 112·2 | 55·92 | 0·27419 | 80·5 | 80·25 | | | |
| ·10 | 115·2 | | 0·27419 | ? 82·9 | 82·65 | 81·25 | 4970 | |
| ·20 | 114·0 | | 0·27419 | 81·8 | 81·55 | | | |
| ·24 | 113·4 | 43·95 | 0·32101 | 97·5 | 97·70 | | | |
| ·32 | 114·9 | | 0·32101 | 97 | 97·20 | 97·5 | 5960 | |
| 15·15 | 111·9 | | 0·33753 | 96·5 | 97·61 | | | |
| ·25 | 113·6 | 38·57 | 0·41013 | 111·1 | 111·1 | | | |
| ·29 | 112·4 | | 0·40911 | 111·7 | 111·86 | 111·3 | 6808 | |
| ·43 | 113·8 | | 0·41051 | 111·1 | 110·9 | | | |
| ·51 | 113·5 | 26·55 | 0·52473 | 127·25 | 127·25 | | | |
| ·54 | 113·4 | | 0·52462 | 128·9 | 127·35 | 127·42 | 7792 | |
| ·58 | 111·8 | | 0·52462 | 126·9 | 127·34 | | | |
| 16·05 | 113·5 | 21·12 | 0·61301 | 136·7 | 136·1 | | | |
| ·09 | 113·7 | | 0·61301 | 135·25 | 135·25 | 135·7 | 8300 | |
| ·16 | 112·3 | | 0·62495 | 140·2 | 142·04 | | | |
| ·23 | 114·2 | | 0·63169 | 144·275 | 142·76 | 144·6 | 8861 | |
| ·30 | 109·2 | 13·95 | 0·92439 | 146 | 147·12 | | | |
| ·34 | 113·2 | | 0·93729 | 147·1 | 147·02 | 149·07 | 9120 | |
| ·40 | 112·8 | 11·365 | 1·09770 | 150 | 149·4 | | | |
| ·43 | 112·7 | 11·463 | 1·09131 | 150·5 | 150·8 | 150·1 | 9181 | |
| ·51 | 112·5 | 9·249 | 1·23986 | 153·1 | 152·06 | | | |
| ·58 | 112·7 | | 1·2239 | 153·6 | 152·39 | 153·2 | 9370 | |
| 17·03 | 114·4 | 7·58 | 1·34019 | 157·75 | 158·81 | | | |
| ·08 | 109·9 | 7·58 | 1·3151 | 155· | 161·10 | 157·58 | 9640 | |
| ·12 | 111·2 | | 1·3297 | 157· | 157·83 | | | |

# Tuesday 22nd May

Levelled at the Edison Phonograph property as follows:—




Scale 100ft to 1".

The black ink figures are the level taken by ourselves. The red ink figures are those by the surveyor reduced from decimals of a foot to feet & inches. The red ink figures running across the line are those marked on the stakes as level above and below the Stake A

5 Lalande cells were set up at noon on the 19th May. as follows. with flake oxide of Copper

| No. | Chemicals | P.D. | E.M.F | C. | I.R. |
|---|---|---|---|---|---|
| 22 | 20% $NH_4Cl$ | 0·203 | 0·223 | 0·609 | 0·032 ? Polarising |
| 23 | 20% KHO | 0·610 | 0·955 | 1·830 | 0·018 |
| 24 | 20% KHO | 0·506 | 0·542 | 1·518 | 0·023 |
| 25 | 20% KHO | 0·574 | 0·943 | 1·722 | 0·021 |
| 26 | 20% KHO | 0·590 | 0·948 | 1·770 | 0·020 |

Lalande cells.

| No. | Time | Hours for start | Solution | Peroxide | P.D. | EMF | Q | S.R. |
|---|---|---|---|---|---|---|---|---|
| 22 | 15.30 | 75 hours | $NH_4Cl$ | flake | 0.162 | 0.234 | 0.496 | 0.148 |
| 23 | | " | KHO | " | 0.500 | 0.590 | 1.500 | 0.060 |
| 24 | | " | Removed | | 0 | | | |
| 25 | | " | KHO | " | 0.514 | 0.604 | 1.542 | 0.058 |
| 26 | | " | KHO | " | 0.492 | 0.670 | 1.476 | 0.120 |
| 27 | | 0 | $NH_4Cl$ | powder | 0.300 | 0.354 | 0.900 | 0.060 |
| 28 | | " | " | " | 0.450 | 0.508 | 1.350 | 0.042 |
| 29 | | " | " | " | 0.544 | 0.565 | 1.632 | 0.012 |
| 30 | | " | " | flake | 0.470 | 0.514 | 1.410 | 0.031 |
| 31 | | " | " | " | 0.544 | 0.594 | 1.632 | 0.030 |
| 32 | | " | " | " | 0.568 | 0.610 | 1.704 | 0.030 |
| 19.10 | 18.00 | | | | | | | |
| 23 | | 11½ | KHO | flake | 0.490 | 0.580 | 1.470 | 0.061 |
| 25 | | " | " | " | 0.510 | 0.616 | 1.530 | 0.069 |
| 26 | | " | " | " | 0.482 | 0.580 | 1.446 | 0.067 |
| 27 | | 2½ | $NH_4Cl$ | powder | 0.294 | 0.350 | 0.882 | 0.063 |
| 28 | | 2½ | " | " | 0.384 | 0.446 | 1.152 | 0.053 |
| 29 | | " | " | " | 0.504 | 0.538 | 1.512 | 0.022 |
| 30 | | " | " | flake | 0.430 | 0.466 | 1.290 | 0.027 |
| 31 | | " | " | " | 0.470 | 0.550 | 1.410 | 0.056 |
| 32 | | " | " | " | 0.522 | 0.558 | 1.566 | 0.022 |
| 23.10.15 | 8.00 | | | | | | | |
| 23 | | 9½ | KHO | flake | 0.382 | 0.464 | 1.146 | 0.071 |
| 25 | | | " | " | 0.400 | 0.490 | 1.200 | 0.076 |
| 26 | | | " | " | 0.381 | 0.460 | 1.143 | 0.069 |
| 27 | | 16½ | $NH_4Cl$ | powder | 0.260 | 0.350 | 0.880 | 0.102 |
| 28 | | | | " | 0.228 | 0.290 | 0.684 | 0.090 |
| 29 | | | | | 0.464 | 0.504 | 1.392 | 0.040 |
| 30 | | | | flake | 0.288 | 0.330 | 0.864 | 0.048 |
| 31 | | | | " | 0.400 | 0.474 | 1.200 | 0.061 |
| 32 | | | | " | 0.478 | 0.522 | 1.434 | 0.030 |

T.C. 15·6c. Pendulum swing T. L P. D. 3 cm.

EMF 1·4373

Disch. from 1 C.C. 0·5t

| | | | |
|---|---|---|---|
| 131 | L X2 = | 262 | = 0·65 |
| 131·9 | R X2 = | 263·8 | = 1·62 |
| 132·1 | R X2 = | 264·2 | = 2·52 |
| ? 130·1 | L X1 = | 130·1 | = 1·24 |
| 131·0 | R X2 = | 262 | = 0·68 |
| | | 4 \| 1132·1 | 5·5·24 |
| | Mean. | 131·34 | ± 0·37 |

Disch. from 1. C.C. 0·5t

| | |
|---|---|
| 130·5 | −0·25 |
| 130·25 | +0·05 |
| 130·0 | +0·25 |
| 130·25 | 0·05 |

EMF 1·4358 = 130·25 ± 0·1

$$\mathcal{L} = \frac{d \times 0{\cdot}71828 \times 51{\cdot}64}{130{\cdot}795 \times 46{\cdot}57} = 60{\cdot}895.$$



| Time | Volts | Ohms | Ind. C. | Amp. turns | Thickness | Corrected | Mean | Lines per cm. |
|---|---|---|---|---|---|---|---|---|
| 10·17 | - | - | | | 1·78 | 1·78 | | |
| ·24 | - | - | | | 1·90 | 1·90 | 1·78 | 108. |
| ·27 | | | | | 1·7 | 1·7 | | |
| ·36 | 101·5 | 22+260 | 0·1 | 190·5 | 4·5 | 4·5 | | |
| ·47 | 100·2 | | 0·1005 | | 4·8 | 4·78 | 4·64 | 232·6 |
| ·53 | 101·2 | | 0·099 | | 4·5 | 4·54 | | |
| 11·09 | 102·7 | 12+300 | 0·205 | 391 | 9·4 | 9·17 | | |
| ·16 | 102·0 | | 0·20 | | 8·75 | 8·76 | 8·98 | 546·8 |
| ·26 | 103·5 | | 0·20 | | 9·0 | 9·0 | | |
| ·33 | 106·5 | 12+352 | 0·140 | 762 | 17·3 | 17·3 | | |
| ·39 | 106·5 | | 0·140 | | 17·5 | 17·5 | 17·4 | 1059·5 |
| ·52 | 103·7 | | 0·140 | | 17·4 | 17·4 | | |
| ·40 | 108·5 | 117·5 | 0·13261 | 1905 | 40·1 | 40·72 | | |
| ·48 | 102·7 | | 0·13313 | | 40·8 | 41·19 | 41·4 | 2521 |
| ·54 | 103·3 | 116·5 | 0·13609 | | 41·4 | 41·52 | | |
| ·59 | 103·2 | 116 | 0·13669 | | 41·4 | 41·44 | | |
| 13·29 | 109·7 | 75·405 | 0·20497 | 2598 | ? 62·8 | 62·83 | | |
| ·36 | 111·2 | | " | | 59·0 | 59·03 | | |
| ·33 | 110·5 | | " | | 58·3 | 58·32 | 59·62 | 2631 |
| ·42 | 111·7 | | " | | 58·9 | 58·92 | | |
| ·51 | 109·1 | 55·06 | 0·27263 | ~~1762~~ 3810 | 73·2 | 73·40 | | |
| ·57 | 109·7 | | " | | 73·1 | 73·31 | 73·48 | 1447·5 |
| 14·04 | 109·2 | - | " | | ? 73·8 | 74·00 | | |
| ·14 | 109·0 | 43·24 | 0·34270 | ~~5744~~ 10762 | 87·0 | 86·75 | " | |
| ·19 | 109·6 | - | 0·34140 | | 89·9 | 89·98 | | |
| ·23 | 109·4 | - | 0·34183 | | 86·4 | 86·37 | 88·37 | 5211 |
| ·29 | 110·5 | - | 0·34108 | 9 | 81·2 | 81·27 | | |
| ·33 | 110·2 | - | 0·34270 | | 88·2 | 88·26 | | |
| ·45 | 110·2 | 35·31 | 0·40911 | ~~7600~~ 15715 | 95·5 | 95·48 | | |
| ·52 | 111·2 | | 0·40911 | | 100·8 | 102·3 | 101·04 | 6153 |
| ·58 | 111·7 | | 0·40911 | | 102·6 | 102·9 | | |
| 15·07 | 111·6 | | 0·40761 | | 102·3 | 102·06 | | |
| ·21 | 111·5 | 22·06 | 0·52633 | ~~9525~~ 7620 | 121·5 | ~~122·36~~ 120·40 | 1208 | 7356 |
| ·27 | 111·5 | | 0·52672 | | 121·1 | | | |
| ·31 | 111·3 | | 0·52673 | | 120·1 | | | |
| ·40 | 111·5 | 19·75 | 0·68088 | 9525 | 128·9 | 129·36 | | |
| ·44 | 111·4 | - | 0·68301 | | ? 129·5 | 129·55 | 129·69 | 7897 |
| ·52 | 112·0 | - | 0·68311 | | 130 | 130·07 | | |
| ·59 | 111·9 | 16·62 | 0·81946 | 11430 | 135 | 135·1 | | |
| 16·07 | 111·1 | - | 0·81946 | | 135·5 | 135·6 | 135·35 | 8242 |
| ·17 | 112·5 | 13·49 | 0·95729 | 13335 | 140·8 | 140·7 | | |
| ·21 | 112·7 | - | 0·95729 | | 140·3 | 140·2 | 140·57 | 8560 |
| ·26 | 113·0 | | 0·95729 | | 140·9 | 140·8 | | |
| ·39 | 113·3 | 11·08 | 1·09125 | 15240 | 143·4 | 143·3 | 143·08 | 8714 |
| ·46 | 113·2 | - | 1·0977 | | 144·25 | 142·85 | | |
| ·52 | 113·5 | 9·25 | 1·2223 | 17145 | 146·9 | 148·1 | 147·79 | 9000 |
| ·57 | 113·9 | | 1·2229 | | 146·7 | 147·45 | | |
| 17·03 | 112·5 | 7·80 | 1·3680 | 19050 | 148·9 | 148·78 | | |
| ·07 | 113·2 | - | 1·3698 | | ? 148·85 | 149·19 | 149·27 | 9029 |
| ·12 | 112·2 | | 1·3814 | | ? 148·0 | 148·92 | | |

22.5.88 | Interpolar Dist 3·5 cm. Swing 7°

1 B.B. 0·5 f E.M.F. 1·4253 = 0·7177 coulomb, ×10⁻⁶

| | |
|---|---|
| 131 | −0·25 |
| 132·5 | −1·75 |
| 134 | −3·25 |
| 135·5 | +5·25 |
| 3·0 | 10·5 |

Mean 130·75 ± 1·3

$$\frac{0.84253 \times 10^{-5}}{4 \times 1.73} = 1.28$$

17. orbit

131·5 × 2 = 263·0
132·1 × 2 = 264·2
132·7 × 1 = 132·7
132·2 × 2 = 264·4
7924·3
132·04

132·04
130·75
262·79
131·4

$$\mathcal{L} = \frac{\text{dt} \times 0.7177 \times 5225}{131.4 \times 46.57} = \frac{37499825}{6119298} = 61.281$$

log 7·177 = 8559 44
5225 = 718 09
5740 3
7867 1
79732 = 6129

log 131·4 = 11860
46·57 = 66811
78671

| Time | Volts | Ohms. | Ind. B. | Amperes | Phase | Corrected | Mean | $\mathcal{L}$ | Volts |
|---|---|---|---|---|---|---|---|---|---|
| 10·06 | 115·5 | 32+268 | 0·1 | 190·5 | 3·2 | 3·2 | | | |
| ·10 | 113·7 | | 0·10 | | 3·3 | 3·3 | 3·29 | 202 | |
| ·16 | 114·2 | | 0·1095 | | 3·26 | 3·38 | | | |
| ·25 | 115·4 | 12+312 | 0·20 | 381 | 7·25 | 7·25 | | | |
| ·30 | 115·2 | | 0·2 | | ? 8·14 | ? 8·14 | | | |
| ·38 | 114·6 | | 0·2 | | 7·24 | 7·2 | 7·46 | 457 | |
| ·46 | 114·6 | 12+65 | 0·2 | 762 | 14·7 | 14·7 | | | |
| ·52 | 115·[illegible] | | 0·2 | | 15·5 | 15·5 | 15·4 | 944 | |
| ·59 | 114·4 | | 0·2 | | 15·9 | 15·9 | | | |
| 11·11 | 113·5 | 133·23 | 0·13469 | 190·5 | 39 | 39 | | | |
| ·15 | 112·1 | | 0·13469 | | 39 | 39 | 39·0 | 2390 | |
| ·24 | 113·9 | | 0·13469 | | 39 | 39 | | | |
| ·39 | 114·4 | 73·02 | 0·20447 | 2817 | 56·3 | 56·31 | | | |
| ·44 | 114·2 | | 0·20447 | | 57 | 57·01 | | | |
| ·48 | 114·8 | | 0·20449 | | ? 57·6 | ? 57·19 | 56·77 | 3480 | |
| ·57 | 113·2 | 54·11 | 0·27263 | 3810 | 71·1 | 71·29 | | | |
| 12·18 | 113·2 | | 0·27263 | | 71·3 | 71·49 | 71·56 | 4390 | |
| ·21 | 113·0 | | 0·27263 | | 71·7 | 71·89 | | | |
| ·31 | 113·9 | 44·08 | 0·33265 | 4762 | 83·1 | 83·65 | | | |
| ·41 | 113·5 | | 0·33105 | | 84·2 | 84·36 | 84·26 | 5760 | |
| ·48 | 113·5 | 43·29 | 0·33105 | | ? 85 | ? 85·16 | | | |
| ·55 | 113·2 | 35·31 | 0·40051 | 5715 | 98·9 | 98·72 | | | |
| 13·09 | 113·3 | [illegible] | 0·40051 | | 98·1 | 97·92 | 97·85 | 5996 | |
| ·16 | 113·0 | | 0·40911 | | 96·7 | 96·92 | | | |
| ·15 | 112·7 | 26·06 | 0·54673 | 7620 | 113 | 113 | | | |
| ·19 | 113·3 | | 0·54673 | | 113·9 | 113·9 | | | |
| ·21 | 112·7 | | 0·54673 | | ? 114·75 | ? 114·75 | 114·72 | 7020 | |
| ·24 | 113·3 | | 0·54673 | | 115 | 115·0 | | | |
| ·31 | 111·4 | 19·85 | 0·67401 | 9525 | 123 | 124·62 | | | |
| ·38 | 112·1 | | 0·68301 | | 123·5 | 123·37 | 124·22 | 7610 | |
| ·43 | 112·3 | 24·95 | 0·68301 | | 124·4 | 124·47 | | | |
| ·53 | 112·3 | 16·72 | 0·82423 | 11430 | ? 130 | 128·87 | | | |
| ·59 | 112·2 | | 0·82423 | | 129 | 127·77 | 127·94 | 7840 | |
| 15·04 | 112·3 | | 0·82423 | | 127·1 | 127·67 | | | |
| ·11 | 112·2 | 13·75 | 0·95621 | 13395 | 134·8 | 135·12 | | | |
| ·14 | 112·6 | | 0·95621 | | 134·7 | 135·02 | 135·07 | 8280 | |
| ·22 | 112·4 | 11·37 | 1·07145 | 15240 | 139 | 138·87 | | | |
| ·25 | 112·4 | | 1·07145 | | 138·2 | 138·07 | 138·47 | 8490 | |
| ·31 | 111·0 | 9·25 | 1·2276 | 17145 | 142·8 | 142·10 | | | |
| ·34 | 111·3 | | 1·2276 | | 143·7 | 142·00 | 142·55 | 8500 | |
| ·40 | 112·5 | 7·99 | 1·3680 | 19050 | ? 144·6 | 144·49 | | | |
| ·42 | 112·1 | | 1·3638 | | 144·7 | 145·02 | 144·36 | 8852 | |
| ·44 | 111·6 | | 1·3680 | | ? 143·7 | 145·57 | | | |

Leclanché cells

| No. | Date | Time | Hours at work | P.D. | E.M.F. | C. | I.R. | Solution | Oxide |
|---|---|---|---|---|---|---|---|---|---|
| 23 | May 23 | 17. | 100 | 0.392 | 0.455 | 1.176 | 0.053 | 30% KHO | flake |
| 25 | | | 100 | 0.400 | 0.472 | 1.200 | 0.060 | 30% KHO | " |
| 26 | | | 100 | 0.370 | 0.446 | 1.110 | 0.068 | 30% KHO | |
| 27 | | | ~~100~~ 25 | 0.258 | 0.356 | 0.774 | 0.113 | $NH_4Cl$ | powder |
| 28 | | | 25 | 0.214 | 0.278 | 0.642 | 0.099 | $NH_4Cl$ | " |
| 29 | | | 25 | 0.446 | 0.488 | 1.338 | 0.031 | $NH_4Cl$ | " |
| 30 | | | 25 | 0.200 | 0.232 | 0.600 | 0.053 | $NH_4Cl$ | flake |
| 31 | | | 25 | 0.375 | 0.460 | 1.125 | 0.075 | $NH_4Cl$ | " |
| 32 | | | 25 | 0.444 | 0.494 | 1.332 | 0.038 | $NH_4Cl$ | " |
| 23 | May 24 | 8. | 115 | 0.302 | 0.336 | 0.906 | 0.031 | 30% KHO | flake |
| 25 | | | " | 0.302 | 0.370 | 0.906 | 0.075 | 30% " | " |
| 26 | | | " | 0.056 | 0.062 | 0.168 | 0.030 | 30% " | " Removed |
| 27 | | | 40 | 0.244 | 0.340 | 0.732 | 0.131 | $NH_4Cl$ | powder |
| 28 | | | " | 0.256 | 0.350 | 0.768 | 0.122 | " | " |
| 29 | | | " | 0.408 | 0.450 | 1.224 | 0.034 | " | " |
| 30 | | | " | 0.120 | 0.158 | 0.390 | 0.071 | " | flake |
| 31 | | | " | 0.258 | 0.364 | 0.774 | 0.108 | " | " |
| 32 | | | " | 0.306 | 0.358 | 0.918 | 0.045 | " | " |
| 33 | May 24 | 16 | 0 | 0.852 | 0.612 | 1.656 | 0.086 | 20% Leclanché | powder |
| 34 | | | 0 | 0.578 | 0.724 | 1.554 | 0.123 | 15% $NH_4Cl$ | " |
| 35 | | | 0 | 0.578 | 0.623 | 1.554 | 0.067 | 10% $NH_4Cl$ | " |
| 36 | | | 0 | 0.744 | 0.702 | 1.332 | 0.193 | 5% $NH_4Cl$ | " |
| 23 | May 24 | 17 | 124 | 0.096 | 0.226 | 0.198 | 0.607 | removed | |
| 25 | | | " | 0.0 | 0.0 | " | " | | |
| 27 | | | 149 | 0.224 | 0.300 | 0.672 | 0.111 | $NH_4Cl$ | powder |
| 28 | | | " | 0.254 | 0.368 | 0.762 | 0.111 | $NH_4Cl$ | " |
| 29 | | | " | 0.374 | 0.422 | 1.122 | 0.042 | $NH_4Cl$ | " |
| 31 | | | " | 0.200 | 0.274 | 0.600 | 0.123 | $NH_4Cl$ | flake |
| 32 | | | " | 0.187 | 0.210 | 0.561 | 0.040 | $NH_4Cl$ | flake |
| 33 | | | " | 0.562 | 0.580 | 1.506 | 0.051 | 20% NaCl | powder |
| 34 | | | " | 0.532 | 0.584 | 1.596 | 0.046 | 15% " | " |
| 35 | | | " | 0.503 | 0.567 | 1.509 | 0.042 | 10% " | " |
| 36 | | | " | 0.468 | 0.568 | 1.404 | 0.071 | 5% " | " |

Interplay Dist. 4 cones. T swing. 24th May 1888

Res. of Magnet 5.35 − 0.578 = 4.772
" Circuit 3.52 − 0.365 = 3.155

Disch. Standard cell 1.434 volts = 0.717 "

133.8
134.4
133.3
133.8
133.8

After Reading had been taken.

136.75
135.5
135.6
134.8
134.9
26.55
13.5.3

135.3
133.8 } 134.55 Mean

$$\mathcal{L} = \frac{dx \times 0.7177 \times 5225}{134.55 \times 46.57} = \frac{37\,5000}{6266} = 59.85$$

| Time | Volts | Ohms | Ind. C. | Throw | Throw | Throw | Corrected | Mean | $\mathcal{L}$ |
|---|---|---|---|---|---|---|---|---|---|
| 9.45 | 113.4 | 2C+225 | 0.1 | 190.5 | 3.3 | 3.2 | | | |
| ·57 | 113.2 | | | | 3.2 | 3.2 | | 3.23 | 205 |
| 10.07 | 113.6 | | | | 3.8 | 3.8 | | | |
| ·17 | 113.3 | 1C+290 | 0.2 | 381 | 7.6 | 7.60 | | | |
| ·25 | 112.2 | | 0.2008 | | 7.25 | 7.25 | | 7.57 | 453 |
| ·29 | 114.2 | | 0.2005 | | 7.9 | 7.88 | | | |
| ·39 | 113.3 | 1C+682 | 0.397 | 762 | 16.6 | 16.71 | | | |
| ·45 | 112.4 | " | 0.4110 | | 14.7 | 14.34 | | 14.29 | 855 |
| ·52 | 112.2 | " +623 | 0.405 | | 14. | 13.83 | | | |
| 11.11 | 113.4 | 103.6 | 0.13669 | 1905 | 37.9 | 37.9 | | | |
| ·16 | 114.6 | " | 0.13669 | | 37.7 | 37.7 | | 37.73 | 2256 |
| ·19 | 113.8 | " | 0.13669 | | 37.6 | 37.6 | | | |
| ·36 | 113.1 | 73.1 | 0.20457 | 2857 | 56.6 | 56.6 | | | |
| ·40 | 113.0 | " | 0.20457 | | 52.4 | 52.4 | | 52.0 | 3112 |
| ·45 | 112.5 | " | 0.20457 | | 52. | 52.0 | | | |
| ·57 | 112.3 | 55.5 | 0.27127 | 3810 | 65.5 | 66.06 | | | |
| 12.16 | 113.2 | 54.8 | 0.27326 | | 66.5 | 66.50 | | 66.32 | 3968 |
| ·21 | 112.4 | 54.8 | 0.27326 | | 66.4 | 66.40 | | | |
| ·33 | 112.2 | 42.9 | 0.34108 | 4762 | 80.0 | 80.0 | | | |
| ·41 | 114.8 | " | 0.34270 | | 80.5 | 80.27 | | 80.42 | 4812 |
| ·44 | 113.4 | " | 0.34108 | | 81.0 | 81.0 | | | |
| ·59 | 114.0 | 35.5 | 0.40911 | 5715 | 92.1 | 92.31 | | | |
| 13.07 | 113.1 | " | 0.40911 | | 91.5 | 92.10 | | 92.21 | 5518 |
| ·15 | 112.5 | " | 0.40911 | | 92.0 | 92.21 | | | |
| ·29 | 113.5 | 24.3 | 0.52673 | 7620 | 109.9 | 109.9 | | | |
| ·35 | 112.7 | 24.3 | 0.52673 | | 109.8 | 109.8 | | 109.60 | 6560 |
| ·41 | 114.2 | " | 0.52762 | | 109.9 | 109.5 | | | |
| ·55 | 112.4 | 20.95 | 0.68088 | 9525 | 119.2 | 119.64 | | | |
| 15.05 | 113.7 | " | 0.68728 | | 119.8 | 119.13 | | 119.26 | 7140 |
| ·15 | 112.4 | " | 0.68301 | | 119. | 119.0 | | | |
| ·24 | 113.3 | 16.72 | 0.82434 | 11430 | 125 | 124.34 | | | |
| ·30 | 113.1 | " | 0.82190 | | 124.4 | 124.13 | | 124.67 | 7463 |
| ·37 | 113.2 | " | 0.82190 | | 125.8 | 125.83 | | | |
| ·44 | 113.0 | 12.83 | 0.97729 | 13335 | 129 | 128.83 | | | |
| ·57 | 113.5 | " | 0.97729 | | 130.1 | 130.03 | | 129.76 | 7769 |
| ·55 | 113.2 | " | 0.97729 | | 130.4 | 130.33 | | | |
| 16.07 | 113.2 | 11.27 | 1.09148 | 15240 | 134.6 | 134.48 | | | |
| ·13 | 113.3 | " | 1.6913 | | 133.2 | 133.46 | | 134.17 | 8032 |
| ·20 | 113.2 | 11.07 | 1.6918 | | ? 134.7 | ? 136.16 | | | |
| ·29 | 112.9 | " | 1.09148 | | 133.7 | 133.58 | | | |
| ·46 | 112.4 | 8.76 | 1.3386 | 17145 | ? 137.3 | ? 137.36 | | | |
| ·57 | 113.2 | " | 1.3386 | | 137.9 | 138.96 | | 137.34 | 8217 |
| 17.55 | 113.3 | 8.86 | 1.2276 | | ? 137.5 | ? 138.09 | | | |
| 17.02 | 112.2 | 7.21 | 1.3764 | 19050 | 140. | 139.03 | | | |
| ·06 | 112.4 | " | 1.3722 | | 140. | 139.46 | | 139.32 | 8337 |
| ·12 | 112.7 | " | 1.3722 | | 140. | 139.46 | | | |

Thursday. 22k May.

The energy developed by a Lalande 30% Lewis potash cell = 204,000 Joules at supply of 1.15 Volts by the curve of March 88.
and 660,000 Joules at supply of 1.05 Volts by the standard curve of Apr: 88.
The mean may be taken as 650,000 Joules.
Cell no 29 of saturated NaOH gave 98,000 Joules at supply of 0.678 for 40 hours.
also 140,000 Joules
at supply of 0.68 for 64 -
The corresponding values for Lewis Potash 30% = 199,000
and 288,000

Saturday 26k May.

Edison house system testing as follows.

| | |
|---|---|
| Insulation of + main (houses off) | 1300 ω |
| - - - ( - - ) | 12,000 ω |
| - - 0 - - - | 200,000 ω |
| Insulation of all 3 | 1,150 varying |
| Archenclos' house joined up Insulation | 1,150 ω Lamp |
| Res: between + and 0. | 190 ω Lyl |
| - - - 0 | 11,000 ω |
| Burke's house joined up also Insulation | 1,125 ω. |
| Res: between + and 0. | 100 ω Lyl |
| - - - 0 | 11,000 ω |
| Edison's house joined up also Insulation | 1,050 ω Lamp |
| Res: between + and 0. | 7.5 ω 46 |
| Res: - - - 0 | 70 ω 5 |

Res: of standard Clark cells about 75 ω each

Weight of Hematite - paraffin core 550 grammes.

1st set $\begin{cases} 1^{st} \text{ semiint } 4.08 \\ 2^{nd} \quad - \quad 83.3 \end{cases}$ $\lambda = \frac{1}{20} \log_e \frac{4.08}{83.3}$

2nd set $\begin{cases} 1^{st} \quad - \quad 483.75 \\ 2^{nd} \quad - \quad 97.5 \end{cases}$ $\lambda = \frac{1}{20} \log_e \frac{483.75}{97.5}$

3rd set $\begin{cases} 1^{st} \quad - \quad 483.75 \\ 2^{nd} \quad - \quad 89.75 \end{cases}$ $\lambda = \frac{1}{20} \log_e \frac{483.75}{89.75}$

$$\frac{H}{G} \frac{T}{\pi} \sin \frac{\theta}{2} \left(1 + \frac{\lambda}{2}\right) = E K$$

where $\frac{H}{G} = \frac{C}{\tan \theta_1} = \frac{E}{R \tan \theta_1}$

$$\therefore K = \frac{T \left(1 + \frac{\lambda}{2}\right) \theta}{2 \pi R \theta_1}$$



The following measurements were taken with a view to determining the accuracy of our measurements with the pendulum using inductometer.

$\lambda$ and T were first determined as follows.

1st series 10 complete vibs in 374.93 sec T = 37.493
2nd - - - - - 375.50 - T = 37.550
3rd - - - - - 375.71 - T = 37.571

Giving to the first ½ the weight of the second and third, we have

0.493
1.000
1.142
2.735 ÷ 5 = 37.547

In 1st series $\lambda$ = 1.03977
- 2nd - $\lambda$ = 1.04004
- 3rd - $\lambda$ = 1.04045

Giving to the first ½ the weight of the second and third, we have $-23 + 8 + 90 = 75 \div 5 = 15$

= 1.04015

The throws from a standard cell 15.0°C (1.4342 volts) and the Elliott .5 ϕ =

136.25
136.8
137.9
136.4

ϕ Mean 136.8 ± 0.25

The same cell in circuit with a high res: of carbon gave deflections.

R 334
L 326
R 323.5
L 315.5 best. $\theta_1$

Best = 315.5 but possible error of ± 5.0

The high res: was measured at $5.4 \times 10^{15}$ but possible error of 0.1 ±

From these values

$$K = \frac{T(1+\frac{1}{3})\theta}{2\pi R\ \theta_1}$$

$T(1+\frac{1}{3}) = 37.547 \times 1.04015 = 39.055$

$T(1+\frac{1}{3})\theta = 5314.2657$

$2\pi = 6.28318$

$\frac{T(1+\frac{1}{3})\theta}{2\pi}$ 845.03101

Taking $R = 5.4 \times 10^{15} + \theta_1 = 315.5$ $R\theta = 17.037 \times 10^{15}$

or $K = 0.16990 \times 10^{15}$ Best result

Taking $R = 5.3$ and $\theta = 310.5$ $R\theta = 16.457 \times 10^{15}$

and $K = 0.5167 \times 10^{15}$ Max. Possible result

Taking $R = 5.5$ and $\theta = 320.5$ $R\theta = 17.6275 \times 10^{15}$

and $K = 0.4824 \times 10^{15}$ Min. Possible result.

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The capacity is therefore correct to 0.2% by the accepted figs: and is certainly within 1.5% of truth.

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Lalands cells

| No. | Date | Time | Hours at work | P.D. | EMF | C. | I.R. | Solution |
|---|---|---|---|---|---|---|---|---|
| 27 | 25.5. | 8. | 64 | × 0.198 | 0.312 | 0.594 | 0.191 | NaOH + powder |
| 28 | | | | 0.226 | 0.374 | 0.678 | 0.218 | – – |
| 29 | | | | 0.328 | 0.380 | 0.984 | 0.052 | – – |
| 31 | | | | × 0.155 | 0.236 | 0.465 | 0.074 | – flake |
| 33 | | | 16 | 0.476 | 0.542 | 1.428 | 0.039 | 20% NaOH |
| 34 | | | | 0.397 | 0.444 | 1.191 | 0.047 | 15% – – |
| 35 | | | | 0.472 | 0.556 | 1.416 | 0.039 | 10% – – |
| 36 | | | | 0.338 | 0.498 | 1.014 | 0.157 | 5% – – |
| 28 | 25.5. | 17. | 73 | 0.215 | 0.374 | 0.645 | 0.242 | NaOH powder |
| 29 | | | | 0.314 | 0.366 | 0.942 | 0.055 | – – |
| 33 | | | 25 | 0.364 | 0.543 | 1.092 | 0.163 | 20% NaOH – |
| 34 | | | | 0.346 | 0.424 | 1.098 | 0.052 | 15% – – |
| 35 | | | | 0.419 | 0.500 | 1.257 | 0.064 | 10% – – |
| 36 | | | | 0.302 | 0.466 | 0.906 | 0.181 | 5% – – |
| 28 | 26.5 | 8 | 88 | × 0.185 | 0.354 | 0.555 | 0.124 | NaOH powder |
| 29 | | | | 0.264 | 0.316 | 0.792 | 0.065 | – – |
| 33 | | | | 0.406 | 0.512 | 1.218 | 0.037 | 20% NaOH |
| 34 | | | | 0.210 | 0.276 | 0.630 | 0.045 | 15% – |
| 35 | | | | 0.316 | 0.466 | 0.948 | 0.157 | 10% – |
| 36 | | | | 0.263 | 0.414 | 0.789 | 0.226 | 5% – – |
| 29 | 26.5. | 16 | 81 | 0.250 | 0.296 | c | | |
| 33 | | | | 0.408 | 0.570 | | | |
| 34 | | | | 0.140 | 0.200 | | | |
| 35 | | | | 0.392 | 0.485 | | | |
| 36 | | | | 0.283 | 0.420 | | | |

## Monday 28th May.

If 1 H.P. cost $60 per ann. what will be the cost of evolving Chlorine gas from NaCl by Electrolysis?

Using Carbon electrode Cl will appear at the anode and Sodium at the cathode, which in turn will be converted into Soda evolving hydrogen from the water.

The g. Calories evolved by the union of two equivalent of hydrogen and Chlorine appears from Wiedemann's book to be 17,400 so that the E.M.F. would be $\frac{17,400 \times 4.2}{79,3000}$ = 0.8 volt approx.

~~Thus in Jordin~~

10 amperes in one sec. decompose 0.00363 grm. of Cl.

and at 0.8 volt pressure one H.P. = 932 amperes

so that the decomposition is 932 × 0.00363 grm.

for 1 H.P. per sec. = 0.388 grm.

1 H.P. hour = 0.388 × 3600

= 1218 grm.

= 23,1500 lbs per ann. ~~[illegible]~~ = 2.68 lbs. per hour

Tried a couple of carbon sticks in a solution of salt and water. The res. was found to be 625ω with true zero and about 40ω to false zero with approx. the same current 0.05 amperes.

or E.M.F. of polarization = 0.005 (625 − 40)

= 0.005 (585) = 1.7 volts.

Repeated test with greater care

Res. 0.004 amperes + t.z. 810 − 150 = 660

" 0.004 " f.z. 400

EMF of polarization 620 × 0.004 = 2.48 volts.

Placed the rod in HCl dilute.

Res. t.z. 0.005 = 400 − 15 = 385 } 360 × 0.005 EMF 1.8 volts

" f.z. " = 40 − 15 = 25

Sent current of about 1·5 ampères through cell of HCl with carbon electrodes and turned the circuit quickly over from the 100 volt mains to the Potentiometer. The P.D. was about 1·63 volts falling quickly. The same electrodes in NaCl. 2·56 volts

---

The no: of ampères from a HP. @ 2·56 volt = 291
1 Ampère will liberate ~~[illegible]~~ 0·000367 grs per sec
or $3600 \times \cdot 000367$ grs per hour.
$3.6 \times 10^3 \times 3.6 \times 10^{-4} = 1.321$ grs. per hour.
1 HP ∴ gives. $291 \times 10^3 \times 1.321 = 384.4$ grs per hr
$= \frac{384.4}{454} = 0.847$ lbs. ∴

---

The no. of ampères from a HP @ 1·75 volts = 426
1 HP. $426 \times 1.321 = 562.7$ grs. per hour
$= \frac{562.7}{454} = 1.24$ lbs ∴

---

In a year there are about $360 \times 24 = 86400$ hours.
If a HP per ann. cost d dollars.
the price of 1 HP. hour $= \frac{d}{86400}$.
and for this sum p pounds being evolved
∴ 1 pound will cost $\frac{d}{86400p}$

---

Assuming d at 60 Mr Edison's estimate
for NaCl p = 0.85 and price per lb $= \frac{60}{73,440} = \frac{1}{1220}$
$\frac{1}{12}$K of a cent.

---

for HCl p = 1·24 and the price $= \frac{60}{107,000} = \frac{1}{1800}$.
$\frac{1}{18}$K of a cent.

One ampère will deposit 0·0003367 grs. of Zinc per sec = 0·0020202 grs. per min:
= 0·121212 - - hour.
= 0·00267 lbs. - -
or 1 lb. of zinc in 1 hour by 374 ampères.

As an experimental fact 3 ampères deposited 1½ oz = 0·0938 lbs. in 1½ hours from Zinc solution
at rate of 0·0469 .. . .
- - - 0·00335 - - 1 hour.

## Data connected with the heating of a wire by a steady current

Let $\rho$ be the spec: res: of the conductor
$d$ . its diameter
$c$ . the traversing current in abs: units.
Then its area will be $\frac{\pi d^2}{4}$
and its res: per unit length $\frac{4\rho}{\pi d^2}$
The energy liberated by the current per unit of length is thus $\frac{4c^2\rho}{\pi d^2}$ ergs per sec:
and as 1 gram calorie is $4{\cdot}2 \times 10^7$ ergs or $J$
this represents an accession of heat per cm per sec.

$$\frac{4c^2\rho}{J\pi d^2}$$

The specific heat of the metal being $s$ and its mass being $\frac{\pi \delta d^2}{4}$ per unit length; $\delta$ its density
the heat consumed in raising its temp. 1°C
$= \frac{\pi s \delta d^2}{4}$ or through $t$°C $= \frac{\pi s \delta d^2 t}{4}$
and if no heat were lost by the wire $t$ would rise continually for after $n$ seconds

$$\pi s \delta d^2 t \text{ would} = \frac{16c^2\rho n}{J\pi d^2}$$

$$\text{or } t = \frac{16c^2\rho n}{J\pi^2 d^4 s \delta}$$

so that its temp: would increase by $\frac{16c^2\rho}{J\pi^2 d^4 s\delta}$ °C per sec:

But $t$ increases more and more slowly until the Radiation $R$ and convection $V$ which represent the loss of heat per sec: equate the accession of heat per sec: that is until

$$V + R = \frac{4c^2\rho}{J\pi d^2}$$

$$c^2 = \frac{J \pi^2 d^3 k t}{4 \rho}$$



The radiation is per sec.

$t \pi d k$ where $k$ is a constant.

The equation then becomes

$$t \pi d k = \frac{4 c^2 \rho}{J \pi d^2} - V$$

$$\text{or} \quad t = \frac{4 c^2 \rho}{J \pi^2 d^3 k} - \frac{V}{\pi d k}$$

The convection $V$ is probably directly connected f (Surface, $t$) with the (diameter)² and temperature

or $= q \, t \, \frac{\pi d^2}{4}$ in which case

$$\text{or} \quad t = \frac{4 c^2 \rho}{J \pi^2 d^3 k} - \frac{q t d}{4 \pi k}$$

$$\text{or} \quad t \left(1 + \frac{q d}{4 \pi k}\right) = \frac{4 c^2 \rho}{J \pi^2 d^3 k}$$

$$\text{or} \quad t = \frac{4 c^2 \rho \times 4 k}{J \pi^2 d^3 k \cdot (4 k + q d)}$$

$$= \frac{16 k c^2 \rho}{J \pi^2 d^3 k (4 k + d q)}$$

---

Abbreviated the results stand as follows

Heat units developed per cm per sec $= \frac{c^2 \rho}{J}$ where $c$ is 70 per cm
$c$ - current
$J$ - 4·2

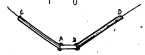
Heat units lost per cm per sec $= t k s + V$ where $t$ is fluid temp
$k$ is cond: const
$s$ is surface.
$V$ is convection

---

The a pair of standard Ω coils supplied by Dr. Muirhead came from London. Their EMF at the same temp: differed from that of our standard by less than 0·06 %. That is to say taking the EMF of our standard as 1·735 at a given temp. that of the Muirhead coils were between the limit certainty of 1·734 and 1·736 and in fact at one time no difference could be apprehended. Their res = 1·735

Tuesday 29th May

Res: of glass at high temperatures.




Two glass tubes, CAB, about 20 cms long and 0·8 cms in diam were connected at their lower ends by a rod of glass 4·9 cms long and 0·8 cms. diam. Two platinum disk electrodes about 1 cm. diam were fused solid between the rod and the tubes so as to be completely enclosed by glass at the points A + B but their edges almost appeared at the surface so that the thickness of glass over their edge must be small. Two platinum wires were riveted to these disks and lead out at the extremities of the tubes through seals at C and D.

This V. tube immersed in salt water showed perfect insulation, that is to say above 60,000 Ω. It was then placed in a sandbath and heat applied. Tinfoil was wrapped over the part AB. A thermometer, was dipped in the sand by the side of the rod AB. The two wires from C + D were taken to a delicate Mirror Galvanometer and 50 Ag/Ag cells. No deflection was observed, all the apparatus well insulated. On applying heat however below the bath the following results were obtained.

| Time | Temp °C. | Galvo Deflectn. | Res: between C + D. |
|---|---|---|---|
| 9.50 | 17° | 0 | > 60,000 Ω |
| 10·0 | 121° | 0·5 div | 54,600 Ω |
| ·16 | 163° | 1·20 - | 27,300 Ω |
| ·18 | 182° | 1·25 - | 21,800 Ω |
| ·28 | 218° | 8·0 - | 3,500 Ω |
| ·30 | 236° | 100 - | 270 Ω |
| ·32 | 242° | 197 - | 140 Ω |
| ·35 | 248° | 300 - | 97 Ω |
| ·38 | 252° | 500 - | 55 Ω |

Stopped experiment at this point and let tube cool. Found tinfoil soft and torn. When cold put tube in water and found. Insulation perfect.

Lalande cells

No. 37. was made up with { ½ Bichromate of Potash
½ Lewis Lup

38 - " - - Bichloride of Tin.

39 - - - - sesquichloride of iron.

Iron grids.

| No. | Date | Time | Hours at work | P.D. | EMF | Q. | R. |
|---|---|---|---|---|---|---|---|
| | | | | Yu | | | |
| 37 | 28.5.88 | 17.15 | 0 | 0.570 | 0.945 | 1.710 | 0.219 |
| 38 | | | | 0.472 | 0.510 | 1.416 | 0.026 |
| 39 | | | | 0.494 | 0.577 | 1.482 | 0.056 |
| 37 | 28.5.88 | 18.0 | 3/4 | 0.522 | 0.704 | 1.566 | 0.116 |
| 38 | | | | 0.476 | 0.518 | 1.429 | 0.029 |
| 39 | | | | 0.492 | 0.500 | 1.476 | 0.065 |
| 37 | 29.5.88 | 8.0 | 14¾ | 0.076 | 0.110 | | |
| 38 | | | | 0.070 | 0.080 | | |
| 39 | | | | 0.288 | 0.380 | | |
| 39 | 29.5.88 | 17.0 | 23¾ | 0.186 | 0.240 | | |

Weights of cores used for determining $\mu$.

| | | | | | |
|---|---|---|---|---|---|
| Norway | lb 4 oz 2.5 | = | 66.5 | = | 1885 grammes |
| Ulster | 4.0 | = | 64 | = | 1815 " |
| S.C. | 3.10.25 | | 58.25 | = | 1651 " |
| N.W. | 3.4 | | 42 | = | 1191 " |
| 5% | 3.11 | | 59 | = | 1673 " |
| 10% Mg. | 3.10.25 | | 58.25 | = | 1651 " |
| Ruffine & Lamotte | | | | | 550 |
| " Hypophosphorus | | | | | 490 |

Need have 5 oz

# Formulae connected with the Magnetisation of solenoids applying strictly only to long thin solenoids

Let $\mathcal{H}$ = Magnetic field of solenoid only (line per sq. cm)
" $c$ = current strength in abs: measure.
" $k$ = susceptibility
" $n$ = no. of turns of solenoid per sq. cm.
" $N$ = total no. of turns
" $a_s$ = area of solenoid
" $a_c$ = area of core.
" $l$ = length of solenoid and core
" $\mathcal{B}$ = Induction (line of force per sq. cm)
" $\mathcal{I}$ = Intensity of Mag: = $k\mathcal{H}$
" $\mathfrak{M}$ = Moment of solenoid and core
" $m$ = " solenoid alone.
" $v_s$ = volume of solenoid (mass if of second kind)
" $v_c$ = " " core.

$$\mathcal{H} = 4\pi n c = m \times \frac{4\pi}{a_s l} \quad \text{or} \quad \bar{m} \times \frac{4\pi}{v_s}$$

$$m = a_s N c = \frac{\mathcal{H} v_s}{4\pi}$$

$$\frac{\mathfrak{M} - m}{l a_c} = \mathcal{I} = k\mathcal{H} \quad \therefore k = \frac{\mathfrak{M}}{\mathcal{H} v_c} - \frac{v_s}{4\pi v_c}$$

$$4\pi\left(\frac{\mathfrak{M} - m}{l a_c}\right) + \mathcal{H} = \mu\mathcal{H} = \mathcal{B} \quad \therefore \mu = 1 + 4\pi k.$$

When $v_s = v_c$ and $a_s = a_c$
this equation becomes

$$\mathcal{B} = \frac{4\pi \mathfrak{M}}{v_c}$$

## Wednesday 30th May

Tried Resistance of Metallic surfaces in a solution of NaOH and distilled water with a copper plate as anode. The arrangement was precisely similar to that given on page 33. The current through the bath was 10 m-amp.

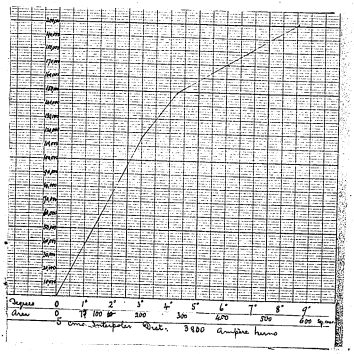
Without previous polarizing the resistances obtained were after steady polarization

| | | | |
|---|---|---|---|
| (1) | Iron 18.5 | (1) | Iron 8.5 |
| (2) | Copper 20.5 | (2) | Aluminum 20.5 |
| (3) | Lead 20.5 | (3) | Zinc 22.5 |
| (3) | Zinc 21.5 | (4) | Silver 23.5 |
| | Brass 23.5 | (5) | Lead 24.5 |
| (4) | Tin 24.5 | (6) | Nickel 25.5 |
| (5) | Silver 24.5 | (7) | Tin 27.5 |
| (6) | Alumin: 27.5 | (8) | Copper 30.5 |
| (7) | Nickel 28.5 | | |

Particulars of Multipolar Dynamo.

Ring outer circumference 263 cm. Diam 83.8 cms
Inner " " 215 " 68.6.
Area of ring Cross sectional 135 sq. cms.
No. of turns of wire 180.
Distance apart on outer circumference 1.46 cms.

At a speed of 825 revs: per min or 13.75 per sec. the volts at the terminal were 85 and the current 440 amperes. The res: of armature 0.004 ω. The Internal EMF would be 86.7, and this is the accumulation of 15 turns, 12 wts in parallel. This means 5.8 volts per turn of wire, and the no. of turns that cut the lines from one pole at the above speed is 2500 embracing an area of 119300 sq. cms. The average induction necessary for this EMF. is 48.6 Gauss. The field magnets were separately excited by the 100 volt mains. The linear circumferential speed is 3600 per sec, and the coils were on each turn = 17.8 + 15.2 = 33 cms.






The following observations of Pendulum swings were taken on the 29th May but their accuracy cannot be greatly depended upon as there was quite perceptible leakage current passing at time through the galvanometer and this could not be entirely got rid of owing to the dampness of the weather. However the leakage currents are given below.

The throws from the standard cell & 0.5T were.

| | |
|---|---|
| 136.4 | 272.8 |
| 137.1 ? | 274.1 |
| 138. | 276.0 |
| 138.8 ? | 138.8 |
| 139. | 278. |

Mean 137.8.

Interpolar Dist 5 cms.

| Current in Magnet | Ampere turns. | Pendulum Swing | Approx. Area Swept out | Amplitude of Needle deflection | Throw. | Lines of Force cut. | Lines per sq cm |
|---|---|---|---|---|---|---|---|
| 2 | 3810 | 8'.35' | 570 | 1.5 ± | 75 | 200,150 | 350 |
| | | 6'.45' | 450 | 1.3 | 67 | 178,700 | 399 |
| | | 6'.35' | 440 | 1.0 | 63.5 | 170,000 | 386 |
| | | 4'.25' | 290 | 1.3 | 55.7 | 149,000 | 514 |
| | | 3'. | 200' | 2.5 | 43.2 | 115,900 | 580 |
| | | 1'.30' | 100 | 0 | 21.2 | 56,900 | 569 |
| | | 1'.10' | 77 | 0 | 16.3 | 43,700 | 567 |

68.75
× 3800
4 18264

at 5 cms.
366530
324200
314480
272120
211680
103930
77412

Before taking Series

Throws from Condenser $0.5 \times 10^{-4} \times 1.2432 \times 10^{3} = 0.716 \times 10^{-1}$

20·7 ? 142·3
? 142·5
? 134·4
143·9
143·3
142·8

} Adjusted Mean 143·0

After taking series

20·3°C 143·2
141·8 } 142·5.

$$\mathcal{L} = \frac{d \times 0.716 \times 5225}{143.0 \times 146.57} = \frac{d \times 3741.1}{6657.95} = d \times 56.176$$

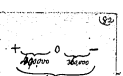
log 716 2·85491
5225 3·71809
57300

143 15·5314
46·87 6·6811
82345
74955 = 5614

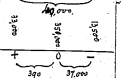
| Time | Volts | 31st May 1888 Ohms. | Ind. L. | Ampère turns | 5 cm Throw | Corrected | Adjusted Mean | $\mathcal{L}$ |
|---|---|---|---|---|---|---|---|---|
| 10·12 | 113·6 | 32+240 | 0·0995 | 190·5 | 4 | 4 | 4·2 | 236 |
| ·27 | 112·7 | | 0·0995 | | 4·1 | 4·1 | | |
| ·38 | 112·5 | | 0·1009 | | 4·2 | 4·5 | | |
| 11·10 | 125·2 | 12+200 | 0·230 | 381 | 8·2? | 7·13? | 7·2 | 404 |
| ·18 | 126·2 | | 0·200 | | 6·75 | 6·75? | | |
| ·24 | 114·2 | | 0·180 | | 7. | 7·77 | | |
| ·30 | 114·2 | 12+360 | 0·179 | | 6·3? | 7·04 | | |
| ·38 | 112·2 | 12+70 | 0·405 | 762 | 16 ? | 15·8? | 13·9 | ·781 |
| ·41 | 113·0 | | 0·399 | | 13·4 ? | 13·43? | | |
| ·48 | 113·4 | | 0·400 | | 13·9 | 13·9 | | |
| ·53 | 113·0 | | 0·397 | | 14 | 13·61 | | |
| ·59 | 113·4 | | 0·398 | | 12·4? | 12·46? | | |
| 12·24 | 113·3 | 117 | 0·13609 | 1905 | 32·4 | 32·54 | 33·1 | 1859 |
| ·33 | 112·9 | | 0·13609 | | 32·5 | 32·64 | | |
| ·37 | 113·4 | | 0·13609 | | 33·9 | 34·05 | | |
| ·46 | 113·3 | 75·4 | 0·20497 | 2857 | 49·7 | 49·7 | 49·9 | 2803 |
| ·50 | 113·0 | | 0·20497 | | 49·8 | 49·9 | | |
| 16·02 | 113·0 | | 0·20870 | | 50·1 | 50·1 | | |
| ·10 | 113·0 | 55 | 0·27243 | 3810 | 64·5 | 64·67 | 65·55 | 3626 |
| ·13 | 113·0 | | 0·27243 | | 64·2 | 64·37 | | |
| ·18 | 112·6 | | 0·27243 | | 64·5 ? | 64·67? | | |
| ·27 | 112·7 | 34·7 | ~~0·34605~~ | 4762 | ~~77 [illegible]~~ | 77 | 76·8 | 4314 |
| ·32 | 112·2 | | ~~0·34605~~ | | ~~77 [illegible]~~ | 76·7 | | |
| ·37 | 113·0 | | ~~0·34870~~ | | ~~77·8 7~~ | 77·8 | | |
| 20 | 112·7 | 36·2 | 0·40911 | 5715 | 89·4 | 89·6 | 89·6 | 5033 |
| 59 | 113·2 | | 0·40911 | | 89·3 | 89·5 | | |
| 18·09 | 112·0 | | 0·40572 | | 88·7 | 89·6 | | |
| ·27 | 112·5 | 29·6 | 0·54684 | 7620 | 107·1 | 107·147 | 107·4 | 6033 |
| ·34 | 113·3 | | 0·54684 | | 104·4 | 107·77 | | |
| ·37 | 112·6 | | 0·54684 | | 106·5 | 106·87 | | |
| ·45 | 113·0 | 25·9 | 0·68307 | 9525 | 117·7 | 117·7 | 117·3 | 6589 |
| ·55 | 113·3 | | 0·68307 | | 116·1 | 116·1 | | |
| 19·02 | 113·2 | | 0·68307 | | 118·0 | 118·0 | | |
| ·12 | 111·3 | 17·0 | 0·81946 | 11420 | 123·3 | 123·4 | 123·3 | 6927 |
| ·26 | 113·5 | | 0·85673 | | 122·8 | 123·8 | | |
| ·28 | 123·4 | | 0·14976 | | 122·7 | 122·7 | | |
| ·07 | 116·7 | 13·2 | 0·0265 | 13335 | 131·2 | 122·3? | 125·4? | 7044 |
| ·20 | 117·2 | | 1·0265 | | 130· | 121·1? | | |
| 17·01 | 116·6 | | 0·02724 | | 129·2 | 122·1 | | |
| ·13 | 112·5 | 11·2 | 1·07455 | 15240 | 132·4 ? | 135·27? | 135·63 | 7617 |
| ·18 | 112·2 | | 1·0675 | | 131·9 | 137·64 | | |
| ·23 | 111·2 | | 1·2861 | | 131·9 | 132·29 | | |
| ·34 | 112·2 | 8·9 | 12460 | 17148 | 137·2 | 135·46 | 135·25 | 7578 |
| ·40 | 111·3 | | 1·2369 | | 134·9 | 134·39 | | |
| ·43 | 112·6 | | 1·2369 | | 136·4 | 135·86 | | |
| ·52 | 112·0 | 7·31 | 1·3280 | 19080. | 141· | 140·85 | 141·35 | 7943 |
| ·55 | 112·0 | | 1·3628 | | 141·5 | 141·52 | | |

Saturday 2nd June.

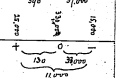
Edison system feed in E.R. chances



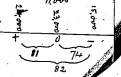

Archimedes in set.




Burke also in set




Edison also in set.




Meter experiment stopped, bottles removed but not opened.

Planimeter indicator 0.1 per sq cm. = 22.7 on bar.

Experiments were made with the multipolar Dynamo to find how much energy was wasted in friction in 1st Engine (Armington Simms running) the No 20 Dynamo (whose armature supplied 11 amperes thro' res.) and the shafting leading to the multipolar Dynamo.

| | Front | Back. |
|---|---|---|
| The diagrams indicated | 4.62 | 4.23 |
| | Total 8.9 say | |

16.05 clock

This was the energy consumed in overcoming the friction of the engine the shafting the No 20 armature, and the supply of 1100 Watts, in current.

17.6 & 17.11

2nd The belting was put on the multipolar armature shaft so as to drive the armature with the brushes off and the field unexcited.

The diagrams gave

| Front | Back |
|---|---|
| 5·89 | |
| 5·49 | |
| | 6·88 |
| | 2·50 |
| 5·69 | 4·69 |
| Total | 10·14 |

shewing 1·5 HP in overcoming friction of armature.

17.17 & 17.21

3rd The 11 amperes from the No 20 machine were taken off the pos and used to charge the field magnets. Bulks multipolar, whose armature ran with the brushes off.

The diagrams gave

| Front | Back |
|---|---|
| | 15·76 |
| | 15·63 |
| | 16·20 |
| 13·25 | |
| 13·22 | |
| Mean 13·24 | 15·86 |
| Total | 29·1 |

Indicated H.P. wasted in Foucault currents 18·7.

The armature became very hot. The field coils were in parallel but ~~shots~~ ~~fairs~~ on each bar were in series.

* no paraffine wax simply pressed tight.



Experiments on the permeability of different magnetic substances.

Three cores were prepared as follows.

* 1st Pyrophoric iron reduced by hydrogen was mingled in a mould with melted paraffine wax. The dimensions of the core produced were

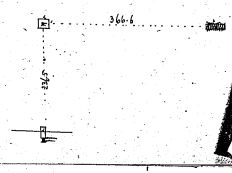
| | |
|---|---|
| Length | 15 |
| Diam | 4·8 |
| Area | 15·00 |
| Volume | 211·4 |
| Mass | 490. |
| Density | 2·32 |

2nd Finely powdered $Fe_2O_3$ in a glass tube without admixture of paraffine. The mass of oxide being 190 grammes the dimensions of the column between ends

| | |
|---|---|
| Length | 15·2 |
| Diam | 4·0 |
| Area | 12·57 |
| Volume | 195·5 |
| Density | 1·02 |

3rd Coarse iron filings in a glass tube with molten paraffine wax.

| | |
|---|---|
| Length | 15 |
| Diam | 4 |
| Area | 12·57 |
| Volume | 188·5 |
| Mass | 381 |
| Density | 2·014 |



## Coil Constants

| Vol. of coil No. | Vol. c.c. | Radius | Area 4πr | 4π/v | |
|---|---|---|---|---|---|
| 1 | 291.1 | 2.469 | 19.87 | 0.4308 | |
| 2 | 307.6 | 2.538 | 20.27 | 0.0397 | |
| 3 | 324.5 | 2.607 | 20.67 | 0.0387 | |
| 4 | 342.2 | 2.677 | 22.48 | | |
| 5 | 360.1 | 2.746 | 23.67 | 0.0349 | |
| 6 | 378.4 | 2.815 | 24.89 | | |
| 7 | 397.1 | 2.884 | 26.15 | | |
| 8 | 416.4 | 2.953 | 27.34 | | |
| 9 | 436.1 | 3.022 | 28.65 | | |
| 10 | 456.2 | 3.091 | 30.09 | 0.0275 | |
| 11 | 476.9 | 3.160 | 31.37 | | |
| 12 | 497.9 | 3.229 | 32.78 | | |
| 13 | 519.4 | 3.298 | 34.21 | | |
| 14 | 541.7 | 3.368 | 35.68 | | |
| 15 | 564.1 | 3.437 | 37.07 | | |
| 16 | 587.0 | 3.506 | 38.59 | | |
| 17 | 610.3 | 3.575 | 40.15 | 0.0206 | |

Have wrong editions except 17.

| $\frac{m-m}{x\,\frac{4\pi}{v}}$ | m-m | H | L |
|---|---|---|---|
| 1.00 | – | | |
| | – | | |
| | – | | |
| 0.0594 | – | | |
| | 507 | 668 | 1075 |
| | 571 | 702 | 1273 |
| | 609 | 770 | 1379 |
| | 678 | 852 | 1525 |
| | 672 | 953 | 1625 |
| | 759 | 1053 | 1842 |
| | 816 | 1180 | 1979 |
| | 872 | 1260 | 2152 |
| | 951 | 1440 | 2391 |
| | 1080 | 1622 | 2672 |
| | 1176 | 1845 | 2021 |
| | 1279 | 1918 | 3196 |



## Coil without Core.

n = 6.985
4πn = 86.52

| No. of coils in coil. | Scale deflection dg | Obrach horiz. deflection | Current. | Moment cgs H. Comp | H.N.C. Average Field H Line per cm | m × 4π/v Average Field H Line per cm |
|---|---|---|---|---|---|---|
| 1 | 0.48 | 0.556 | 0.291 | 9.449 | 25.12 | 407 |
| 5 | 0.88 | 0.518 | 0.271 | 17.326 | 117. | 606 |
| 10 | 1.19 | 0.482 | 0.253 | 23.426 | 217. | 644 |
| 17 | 1.40 | 0.449 | 0.235 | 27.560 | 345. | 568 |
| " | 1.73 | 0.550 | 0.288 | 34.056 | 428. | 702 |
| " | 1.90 | 0.590 | 0.309 | 37.403 | 453 | 770 |
| " | 2.10 | 0.600 | 0.341 | 41.340 | 499 | 852 |
| " | 2.35 | 0.725 | 0.380 | 46.262 | 557 | 953 |
| " | 2.67 | 0.805 | 0.422 | 52.562 | 618 | 1083 |
| " | 2.66 | 0.771 | 0.404 | 52.365 | 592 | 1079 |
| " | 2.86 | 0.87 | 0.456 | 56.303 | 668 | 1160 |
| " | 3.13 | 0.955 | 0.500 | 61.617 | 733 | 1269 |
| " | 3.11 | 0.950 | 0.498 | 61.224 | 730 | 1261 |
| " | 3.47 | 1.091 | 0.572 | 68.301 | 838 | 1407 |
| " | 3.90 | 1.21 | 0.634 | 76.775 | 930 | 1582 |
| " | 4.20 | 1.294 | 0.626 | 78.743 | 917 | 1622 |
| " | 4.55 | 1.35 | 0.707 | 89.570 | 1037 | 1845 |
| " | 4.73 | 1.40 | 0.734 | 93.120 | 1076 | 1918 |

| | a. | Hydrochloric Acid | + | paraffine | | m − m |
|---|---|---|---|---|---|---|
| 1 | 0.55 | 0.552 | 0.294 | 10.824 | 25.14 | 138.00 |
| 3 | 0.82 | 0.522 | 0.284 | 16.156 | 73.5 | |
| 5 | 1.07 | 0.825 | 0.275 | 21.060 | 118.6 | |
| 10 | 1.51 | 0.485 | 0.254 | 29.737 | 219.5 | |
| 17 | 1.93 | 0.445 | 0.233 | 38.027 | 361.9 | 9.820 |
| | 2.24 | 0.548 | 0.287 | 44.099 | 432.8 | 9.600 |
| | 2.40 | 0.584 | 0.306 | 47.249 | 468.6 | 10.200 |
| | 2.61 | 0.644 | 0.337 | 51.383 | 449.7 | 11.400 |
| | 2.91 | 0.715 | 0.375 | 57.289 | 594.3 | 11.300 |
| | 3.30 | 0.807 | 0.423 | 64.947 | 619.9 | 12.770 |
| | 3.57 | 0.877 | 0.456 | 70.283 | 669.1 | 13.720 |
| | 3.92 | 0.957 | 0.501 | 77.173 | 735.2 | 14.470 |
| | 4.39 | 1.068 | 0.612 | 84.424 | 850.4 | 16.000 |
| | 4.[illegible] | 1.195 | 0.626 | 96.663 | 918.0 | 17.660 |
| | 5.[illegible] | 1.34 | 0.702 | 105.279 | 1029.4 | 19.560 |
| | 5.[illegible] | 1.39 | 0.728 | 113.988 | 1067.8 | 21.500 |

| No of Cycle | Post work State Deflection | Pull-up Attach Dem. Deflt | Current Mag. Mom. | Moment | H. | m | |
|---|---|---|---|---|---|---|---|
| 1 | 0.61 | 0.563 | 0.295 | 12,009 | 25.44 | | |
| 3 | 0.90 | 0.539 | 0.282 | 17.718 | 73.13 | | |
| 5 | 1.19 | 0.525 | 0.275 | 23.428 | 118.62 | | |
| 10 | 1.69 | 0.488 | 0.256 | 32.877 | 220.52 | | |
| 17 | 2.08 | 0.448 | 0.235 | 40.944 | 344.16 | | |
| | 2.41 | 0.524 | 0.275 | 47.448 | 402.54 | | |
| | 2.70 | 0.586 | 0.307 | 53.155 | 450.17 | | |
| | 2.95 | 0.642 | 0.336 | 58.077 | 493.19 | | |
| | 3.32 | 0.719 | 0.377 | 65.361 | 582.34 | | |
| | 3.75 | 0.820 | 0.430 | 73.826 | 629.93 | | |
| | 4.05 | 0.874 | 0.458 | 79.732 | 671.42 | | |
| | 4.45 | 0.965 | 0.506 | 87.607 | 741.32 | | |
| | 4.92 | 1.060 | 0.555 | 96.860 | 814.30 | | |
| | 5.43 | 1.173 | 0.615 | 106.900 | 901.11 | | |
| | 6.10 | 1.320 | 0.692 | 120.091 | 1014.04 | | |
| | 6.30 | 1.350 | 0.707 | 124.028 | 1037.08 | | |
| | $Fe_2O_3$ | | | | | | |
| 1 | 0.55 | 0.552 | 0.289 | 10.828 | 24.94 | | |
| 3 | 0.80 | 0.542 | 0.284 | 15.749 | 73.53 | | |
| 5 | 0.98 | 0.512 | 0.268 | 19.293 | 115.69 | | |
| 10 | 1.30 | 0.482 | 0.253 | 25.693 | 217.81 | | |
| 17 | 1.51 | 0.44 | 0.231 | 29.727 | 338.07 | | |
| " | 1.81 | 0.539 | 0.282 | 35.633 | 414.07 | | |
| " | 1.95 | 0.578 | 0.303 | 38.390 | 444.03 | | |
| " | 2.13 | 0.636 | 0.333 | 41.933 | | | |
| " | 2.40 | 0.71 | 0.372 | 47.249 | | | |
| " | 2.75 | 0.80 | 0.419 | 54.139 | | | |
| " | 2.99 | 0.86 | 0.451 | 58.864 | | | |
| " | 3.29 | 0.943 | 0.494 | 64.770 | | | |
| " | 3.65 | 1.041 | 0.545 | 71.858 | | | |
| " | 4.10 | 1.16 | 0.608 | 80.717 | | | |
| " | 4.68 | 1.30 | 0.681 | 92.135 | | | |
| " | 4.84 | 1.345 | 0.705 | 95.285 | | | |

Monday 3rd June.

Dried and weighed meter plates as follow

| Plate No. | Weight 16.5.88 | Joint weight 16.5.88 | Weight 3.6.88 | Joint weight 3.6.88 | Gain | Loss | Dif. |
|---|---|---|---|---|---|---|---|
| 1 | 21.7467 | 43.860 | 21.2397 | 43.8807 | 0.5377 | 0.5058 | 0.0319 |
| 2 | 22.1135 | | 22.6412 | | | | |
| 3 | 22.1071 | 43.698 | 21.5894 | 43.7112 | 0.5236 | 0.5116 | 0.0120 |
| 4 | 21.5908 | | 22.1216 | | | | |
| 5 | 21.3031 | 42.8775 | 20.7852 | 42.9093 | 0.5525 | 0.5148 | 0.0377 |
| 6 | 21.5675 | | 22.1200 | | | | |
| 7 | 22.1361 | 44.3466 | 21.6102 | 44.3566 | 0.5232 | 0.5142 | 0.0090 |
| 8 | 22.2234 | | 22.7456 | | | ~~0.5232~~ | |
| 9 | 21.5071 | 43.8984 | 21.0075 | 43.9182 | 0.5200 | 0.4995 | |
| 10 | 22.3913 | | 22.9110 | | | | |
| 11 | 21.1765 | 43.2674 | 20.6622 | 43.2923 | 0.5294 | 0.5146 | 0.0148 |
| 12 | 22.0908 | | 22.6300 | | | | |
| 13 | 21.4184 | 44.3675 | 20.9059 | 44.3672 | 0.5267 | 0.5135 | 0.0032 |
| 14 | 22.9491 | | 23.4613 | | | | |
| 15 | 22.5124 | 44.9578 | 21.9994 | 44.9582 | 0.5132 | 0.5130 | 0.0011 |
| 16 | 22.4460 | | 22.9592 | | | ~~0.5130~~ | |
| 17 | 22.2052 | 44.1070 | 21.6881 | 44.0975 | 0.5157 | 0.5196 | 0.0039 |
| 18 | 21.8929 | | 22.4086 | | | | |
| 19 | 21.2635 | 43.2652 | 20.8462 | 43.2743 | 0.5263 | 0.5173 | 0.0032 |
| 20 | 21.9017 | | 22.4280 | | | | |
| | | | | | Mean | 5.1261 | |
| | | | | | Neglecting No 9 | 5.1268 | 0.002 |

No 9 had a flaw in the casting filled with sand which losing support fell away.

Res: of leads to galvo, moving wire to 3.1245
Magnet 740

1 C.C. gives through 0.54 @ 17.6°C

134
135.1 ?
134.2 ?
135
135.1 ?

Mean Temp room 19°C.

Mean 134.63 E being 1.4335 volts

$$L = \frac{d \times 0.7169 \times 5203}{134.57 \times 46.57} = 59.52\,d.$$

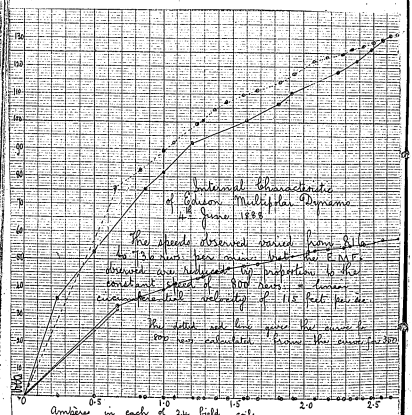
after series of readings 1 C.C. gives @ 20°C.

135.8
134.3
135.0
134.0
134.0

Mean 134.51 E being 1.43325

Mean for day 134.57 div. @ 1.4339 volts

| Time | Volts $10^{-4}$ | Degree 88 Ohms | Ind. C. | T. Times Amplification | 6 Times Ohms | $10^{-2}$ R Corrected | Adjusted Mean | L. |
|---|---|---|---|---|---|---|---|---|
| 11·05 | 112·9 | 24·58 | 0·0993 | 190·5 | 3·5 | 3·5 | | |
| 13·29 | 114·7 | | 0·10 | | 4·0 ? | 4·0 | 3·4 | 202 |
| ·36 | 114·5 | | 0·10 | | 2·6 ? | 2·6 | | |
| ·47 | 114·14 | 12 + 300 | 0·2 | 381 | 5·5 ? | 5·5 | | |
| ·50 | 114·0 | | 0·2 | | 6·1 | 6·1 | 5·9 | 351 |
| ·56 | 114·0 | | 0·2 | | 5·9 ? | 5·9 | | |
| ·58 | 114·0 | — | 0·4 | 762 | 12·1 | 12·1 | | |
| 14·01 | 114·0 | | 0·4 | | 11·7 | 11·7 | 11·92 | 707 |
| ·09 | 114·14 | | 0·389 | | 11·7 ? | 12·0 | | |
| ·17 | 114·3 | 110 | 7'·45' | 1905 | 30·2 | 30·33 | | |
| ·21 | 113·5 | | 7'·30' | | 29·9 | 31·014 | 30·31 | 1804 |
| ·24 | 113·5 | | 7'·45' | | 28·9 | 29·57 | | |
| ·28 | 114·3 | 74·92 | 11°·35' | 2857 | 44·2 ? | 44·01 | | |
| ·38 | 113·3 | | 11°·30' | | 40·3 | 40·61 | 42·49 | 2529 |
| ·42 | 114·2 | | 11°·35' | | 43·6 | 43·61 | | |
| ·49 | 113·5 | 54·07 | 15°·20' | 3810 | 50·5 | 50·35 | | |
| ·53 | 113·2 | | 15°·15' | | 49·9 | 50·04 | 52·66 | 3068 |
| 15·00 | 113·9 | | 15°·15' | | 54·1 | 52·25 | | |
| ·04 | 114·7 | 41·90 | 18°·50' | 4762 | 64·6 | 64·90 | | |
| ·07 | 116·7 | | 19°·30' | | 67·5 | 65·14 | 64·65 | 3848 |
| ·11 | 114·5 | | 19°·55' | | 64·1 | 63·92 | | |
| ·23 | 115·14 | 34·72 | 22°·20' | 5715 | 77·6 ? | 77·46 | | |
| ·27 | 115·9 | | 22°·20' | | 79· | 78·85 | 77·03 | 4586 |
| ·32 | 114·13 | | 22°·25' | | 75·5 | 75·05 | | |
| ·54 | 114·2 | 25·21 | 26°·40' | 7620 | 95 ? | 95·0 | | |
| ·59 | 114·0 | | 28°·40' | | 91·5 | 91·5 | 92·96 | 5833 |
| 16·02 | 113·14 | | 28°·40' | | 93·14 | 93·14 | | |
| ·09 | 115·14 | 20·66 | 32°·40' | 9525 | 100·6 | 99·39 | | |
| ·12 | 115·14 | | 32°·40' | | 103·7 | 102·49 | 101·71 | 6054 |
| ·15 | 115·7 | | 32°·40' | | 105 ? | 103·77 | | |
| ·20 | 112·9 | 16·33 | 39°·15' | 11430 | 109·9 | 110·3 | | |
| ·24 | 113·5 | | 39°·20' | | 111·1 | 111·1 | 110·70 | 6589 |
| ·28 | 113·1 | | 43°·35' | 13335 | 116·50 ? | 116·61 | | |
| ·33 | 112·0 | 13·29 | 43°·35' | | 115· | 116·3 | 116·31 | 6923 |
| ·38 | 111·1 | | 43°·15' | | 116·3 | 117·28 | | |
| ·44 | 111·8 | | 47°·35' | 15240 | 119·8 | 119·69 | | |
| ·49 | 110·5 | 10·49 | 47°·20' | | 119·7 ? | 120·65 | 120·07 | 7143 |
| ·54 | 110·3 | | 47°·15' | | 118·7 | 120·00 | | |
| 17·07 | 113·2 | 8·66 | 51°·10' | 17·145 | 122·5 | 120·3 | | |
| ·01 | 113·14 | | 50°·55' | | 123·5 | 121·91 | 121·11 | 7208 |
| ·10 | 112·9 | 7·21 | 53°·55' | 19·050 | 125 | 124·51 | | |
| ·14 | 113·2 | | 53°·50' | | 124·9 | 124·84 | 124·74 | 7424 |
| ·18 | 114·2 | | 53°·50' | | 125· | 124·90 | | |




Internal Characteristic
of Edison Multipolar Dynamo
14th June 1889

The speeds observed varied from 816 to 736 revs. per minute but the E.M.F.s observed are reduced by proportion to the constant speed of 800 revs. = linear circumferential velocity of 115 feet per sec.

The dotted curve gives the curve for 800 revs. calculated from the curve for 350

Leaf book 3. Page 3.



Tuesday 4th June.

Observed following set of characteristic values for the multipolar dynamo. All the field cores were magnetized separately from the No 20 Dynamo and all 24 were in parallel.

| No. of reading | Amperes in field coils | Amperes in back coils | Speed observed | Speed estimated by ~~Lightfoot~~ | Volts indicated on voltmeter | Volts reduced to 800 revs per min |
|---|---|---|---|---|---|---|
| 1 | 6 | 0·25 | 816 | | 36·5 | 35·8 |
| 2 | 12 | 0·50 | | 816 | 57·5 | 57·4 |
| 3 | 21 | 0·88 | | 816 | 77·0 | 75·5 |
| 4 | 24 | 1·0 | 816 | | 83·2 | 81·6 |
| 5 | 29 | 1·21 | | 810 | 94·0 | 92·2 |
| 6 | 38·5 | 1·60 | | 803 | 107. | 104·6 |
| 7 | 44 | 1·83 | 796 | | 106. | 108·5 |
| 8 | 46 | 1·92 | | 784 | 109. | 110·5 |
| 9 | 54 | 2·25 | | 772 | 114. | 118·8 |
| 10 | 57 | 2·38 | | 760 | 116 | 122·1 |
| 11 | 59·5 | 2·48 | | 748 | 118 | 126·2 |
| 12 | 61·5 | 2·56 | 736 | | 119·5 | 129·9 |
| 13 | 63 | 2·63 | | 730 | 120. | 131·5 |